POPULAR SCIENCE

FOUNDED MONTHLY 1872

AUGUST

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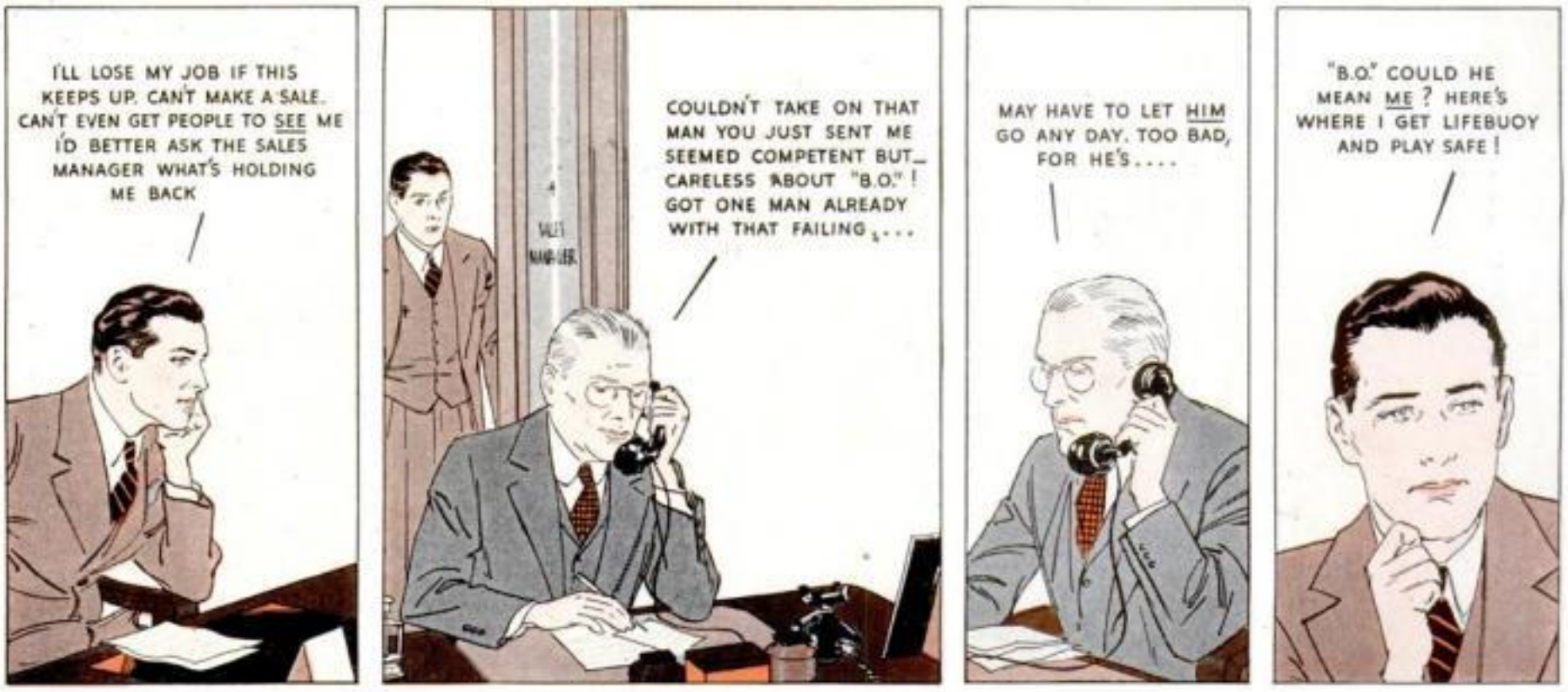
See Page 45

NEW INVENTIONS • MECHANICS • MONEY MAKING IDEAS
HOME WORKSHOP PLANS AND HINTS • 350 PICTURES

....WARNED JUST IN TIME....



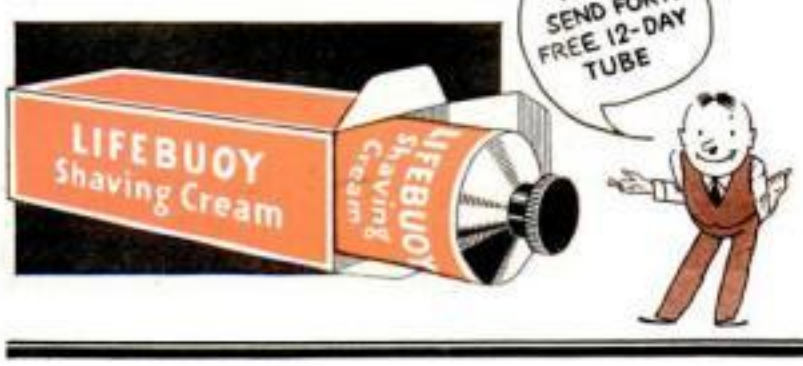
"B.O." (body odor) has crippled many a promising career

THESE days when jobs are hard to get—hard to hold—don't risk the handicap of "B.O." (*body odor*)! The merest hint brands you as careless, undesirable. Play safe this hot, "perspiry" weather—bathe regularly with Lifebuoy. Its clean, fresh, quickly-vanishing scent tells you Lifebuoy is no ordinary toilet soap. Its rich, hygienic lather purifies and *deodorizes* pores—stops "B.O."

Improves complexion, too

Lifebuoy's bland, creamy lather *deep-cleanses* pores—searches out every speck of grimed-in dirt and clogged impurities—makes dull skins fairly glow with health. Women everywhere find Lifebuoy the ideal complexion soap—its gentle lather kind to the most delicate skin.

A new shaving discovery



Quick-drying lather ruins many a shave

This new extra-moist lather soaks beards soft for clean, lasting shaves

MAN, you've never had a really clean shave until you've had a "Lifebuoy Shave". Ordinary, quick-drying lather just can't give you a smooth, lasting shave. But Lifebuoy Shaving Cream lather is extra-moist—holds 52% more moisture—holds it to the end of the shave. It *keeps whiskers soaked soft—extra-soft.* Thus you get the cleanest, fastest, best-feeling shave of your life. It's easy on the face, too, leaves it soft, pliant, refreshed. Try it. Get the big, red tube at your druggist's. Or write for a free trial tube to Lever Brothers Co., Dept. A-148, Cambridge, Mass. (*This offer good in U. S. and Canada only.*)

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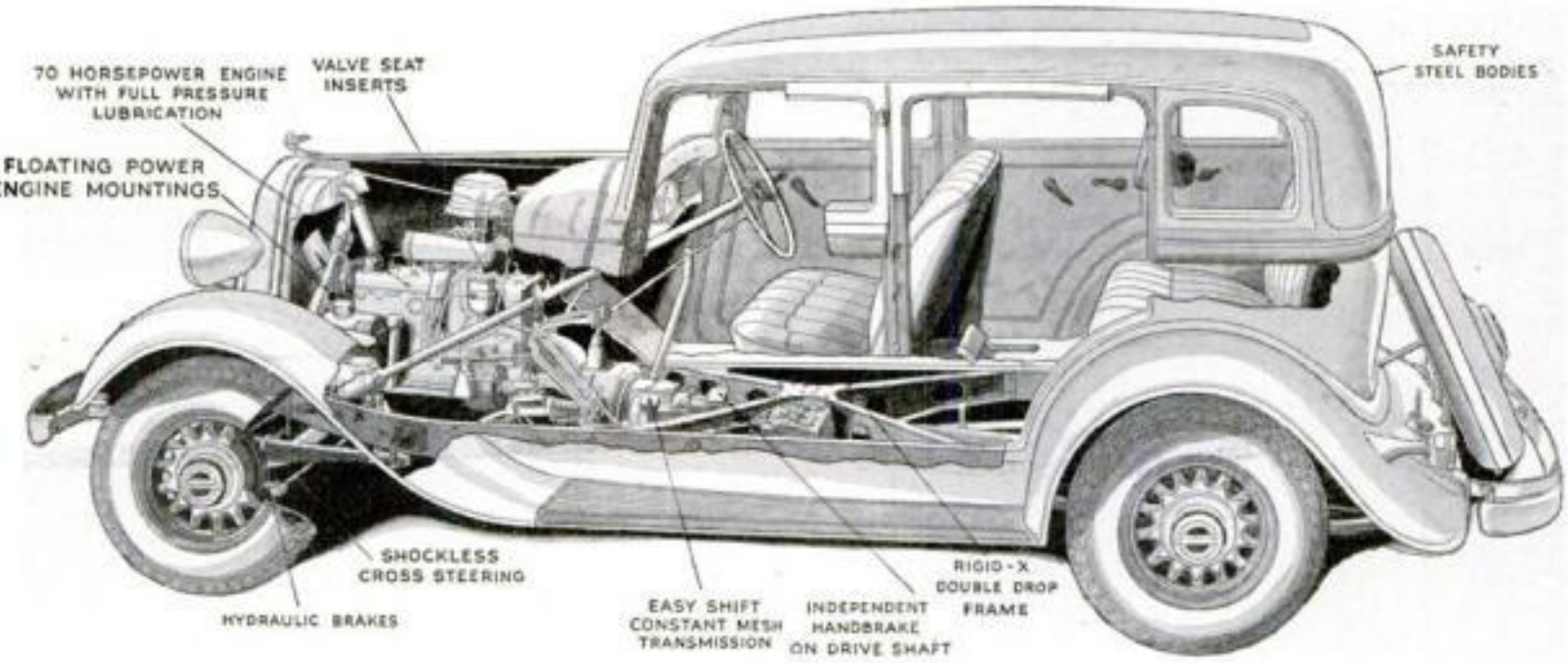
Famous Engineer Explains Vital Features of 2 New Plymouths



FRED M. ZEDER *points out 9 Important Features that make the New Plymouth the Biggest Value in the low-priced field!*

"TAKE a look at this drawing for a minute. If you are mechanically-minded, it will show you what a real job of engineering Plymouth is!

"We haven't compromised with anything. We have given you all the features of our most expensive car.

"Comparison will show that no other low-priced car . . . and only a few expensive ones . . . has *all* of these vital features.

"And they all add up to value . . . to safety . . . to performance.

"Floating Power engine mountings are patented and exclusive to Plymouth at this price. Hydraulic brakes . . . a safety-steel body . . . a substantial rigid-X double-drop frame . . . are important Plymouth safety features.

"Heat-resisting valve inserts cut valve grinding to once in 30,000 miles. I have deliberately not shown in the drawing at least a dozen other features, such as air cleaners, oil filters and silent U-shackles!

"And when you get behind the wheel . . . out on the road . . . you'll see what taking out needless dead weight and putting in a 70-horse-power engine did to improve performance!

"Sum it all up . . . and you get a bigger . . . more economical . . . and easier-riding automobile . . . at a price as low as the lowest!

"As a man who knows mechanics . . . dig down deep when you 'look at all three'. Compare the engineering . . . *the values!* Plymouth welcomes that common-sense kind of buying!"

• • •

$445
AND UP F.O.B. FACTORY, DETROIT

Standard: 2-door sedan $465; 4-door sedan $510; rumble coupe $485; business coupe $445. De Luxe: 2-door sedan $525; 4-door sedan $575; conv. coupe $595; rumble coupe $545; business coupe $495. All prices, F. O. B., subject to change without notice.

SEE PLYMOUTH AT CHRYSLER MOTORS BUILDING, CHICAGO CENTURY OF PROGRESS

NEW PLYMOUTH SIX *NOW PRICED AS LOW AS THE LOWEST*

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FEATURES AND DEPARTMENTS

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AUTOMOBILES

AVIATION

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POPULAR SCIENCE MONTHLY for AUGUST, 1933

For 10c a month
SIMONIZ
will keep your car always beautiful

Saves time and your car's finish!

Millions say there's nothing like Simoniz for keeping cars beautiful. So Simoniz your car—then it will always look new! Just think, no washing expense any more! After a dusty trip simply wipe off the road dirt with a cloth. A minute and your entire car is sparkling clean again!

And of course, every car's finish needs Simoniz to stop injurious elements from destroying it. So don't put off Simonizing your car! Simoniz protects the finish in all weather—makes it last longer—keeps the colors from fading. ALWAYS SIMONIZ A NEW CAR!

When cars are dulled or discolored the wonderful Simoniz Kleener makes them look new in a jiffy. There's nothing so fast or safe! A remarkable new cleaning feature does away with hard rubbing; anyone can restore the original lustre in a few easy strokes!

Be wise and always insist on the famous Simoniz and Simoniz Kleener for your car! At hardware and accessory stores everywhere.

• Simoniz is also great for furniture, woodwork and all fine finishes.

MOTORISTS WISE • SIMONIZ

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By R. M. BOLEN
Secretary, Popular Science Institute

Summer cooler, left, installed in wall of a dress shop, with which temperature and humidity of the air in the room are controlled. Below, a radiator-type air conditioner that can be substituted in place of an ordinary heating unit

Below, air conditioner that uses steam for summer cooling

Air Conditioning
FOR PROFIT

BY MAKING its own weather, American business saves $15,000,000 a year.

Already more than 200 industries have found conditioned air a source of hidden profits. Textile mills no longer depend on uncertain weather conditions, scorching southern mines bored thousands of feet into the earth are made workable, and food, tobacco, and drug companies reduce waste and spoilage by providing climates to suit their work.

In 1924, the theaters led the way to another profitable field for custom-built coolness. Realizing the importance of comfortable air on sultry summer nights, one New York City motion picture house installed a complete air conditioning plant. Immediately summer attendance increased fifty percent to the tinkling tune of a busy cash register. In 1933, summer-cooled theaters are no longer a novelty.

Now owners of railroads, department stores, restaurants, and small shops boost summer sales and bolster profits with controlled weather. When one large metropolitan department store began conditioning the air in its underground floors, basement sales skyrocketed until they reached half the value of the store's entire summer business.

Above, a central plant conditioner that requires air ducts. At right, a portable cooler, easily moved for use at any point where it is needed

In air conditioning, small beauty shops, bakeries, drug stores, lunch rooms, barber shops, and dress stores have a keen competitive weapon. With it they can distinguish their shops from the average by making them cool and comfortable even when the outside air is muggy and hot. One small chain of clothing stores increased sales thirty percent and one small restaurant reports a sixty percent increase in business. Both obtained the increased profits through a comparatively small investment for cooling equipment.

Comfortable quarters are as important to the small neighborhood dealer as to the nationally known tradesman *(Continued on page 5)*

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AIR CONDITIONING FOR PROFIT

(Continued from page 4)

and to the large manufacturer. No matter how small the shop, it can be made more desirable from the customer's point of view by summer cooling. Popularity means increased sales and profits—a steady aid to ailing budgets.

Air conditioning equipment available to the store owner, office man, and small manufacturer is as diversified in type and price as that designed for home use (P.S.M., June '33, p.4). From a large array of radiatorlike cabinets, central plants, portable ice-cooled chests, and window-sill attachments whose costs cover a wide price range, he can pick just the installation to meet his requirements and his pocketbook. Equipment that will give full year-round comfort including winter heating and humidification as well as summer cooling and dehumidification also can be obtained if desired.

For complete summer conditioning of the air, three things are necessary: The air must be dried, it must be cooled, and it must be circulated. Tests have shown that a cooling of ten degrees is sufficient for comfort in most cases, provided the excessive moisture in the air is removed and the air is circulated to prevent the formation of stagnant areas and hot pockets.

In warm weather the normal moisture content of outdoor air is too high for comfort. This excessive moisture must be removed by cooling the air below its dew point.

The old-fashioned open window provides neither cooling nor dehumidification. At best, it serves merely as an easy entrance for hot air, dirt, and unwanted noises. For real comfort in summer, dry, cool air must be circulated at just the right rate, drafts must be eliminated, and windows and doors kept closed. These conditions are possible only through the use of a carefully designed and constructed air-conditioning unit.

Readers who are interested in the possibilities of summer cooling as a profit maker, can obtain more information on the equipment available by sending six cents for postage for the Popular Science Institute Air Conditioning Bulletin. So that any necessary additional information may be sent you, state when writing for the bulletin, the size of the office, store, or theater to be cooled, present type of heating system, fuel used, and whether year-round conditioning is desired or merely summer cooling and dehumidification.

Now Ready

Two valuable bulletins have been prepared for the readers of POPULAR SCIENCE MONTHLY. One is a new twenty-four-page specification list of the new 1933 radio sets compiled by the Popular Science Institute. It contains full information regarding tubes, prices, wave-lengths, and features. The other, a bulletin on air conditioning, outlines the type of air conditioners available to the home and store owner. There is no charge for these bulletins except postage. To cover mailing send 15 cents for the radio bulletin and 6 cents for the air conditioning bulletin. Both bulletins will be mailed to you upon the receipt of 21 cents.

WHY did Louis Meyer, winner of the 1933 Indianapolis 500-Mile Race—and all cars to finish—insist on Champion Spark Plugs? ★ What does this tenth consecutive Champion victory mean to your own car's performance? ★ Ask your dealer or service station attendant

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CHAMPION
EXTRA-RANGE
SPARK PLUGS

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Our Readers Say

Don't Be So Selfish, Is the Advice Fra' Old Glasgow

Our Readers Say used to amuse me but now, since it turned into a "Grumble Column," it annoys me. Good heavens, what do some people want? Some want more math, some more chemistry, and last month E.A.M., of Montreal, howled for physics and biology! What on earth are they trying to do? Make Popular Science Monthly a periodical textbook? I have always liked your magazine because it has been just what it is called, Popular Science—the science of everyday things around us. I am in a scientific profession myself and am delighted with Popular Science Monthly as a change from the highly technical matter of my work. I quite agree with H.K.E., of Maple City, that the magazine should be left alone. Also like him, I only read what I want and let the rest ride. It would be more intelligent for those smart guys, as you call them in America, to be a trifle less selfish in their ideas and consider other readers.—I. Mc. D., Glasgow, Scotland.

Two Hard Mathematical Problems Are Answered

The problem of G.H., Lohrville, Ia., concerning two concentric circles didn't bother me much. Since the circles are five inches apart, the difference in their diameters is ten inches. Now, the diameters of two circles are in the same ratio as their circumferences. So you put these facts down and find that the diameter of the small circle is 15 inches and that of the large circle is 25 inches. The solution of the problem requiring the area of the letter "N" is too long to give but the required answer, according to the calculations I made, is sixteen square inches.—B. R. F., Exeter, N. H.

He's an Artist's Idea of What an Editor Looks Like

Every time I read Our Readers Say, and it is usually the first thing I turn to in the magazine, I wonder who the gentleman is who is sorting mail at the top of the page. Is he the editor, the mail clerk, or who? Or perhaps he is the reader about to "say" and the piles of paper represent his efforts to write a letter that will make the grade and get itself printed. As I say, I've been wondering about him and have at last come to the conclusion that wondering isn't going to get me anywhere and that I'd better go directly to headquarters and ask you just exactly what the significance of the gentleman is?—L. E. O'D., Buffalo, N. Y.

"Honor" Plates for Autos Might Quietly Disappear

According to the founder of a private safety campaign in this fair state of ours, reckless driving could be curbed by a simple system of "honor" licenses. These special licenses, issued only to careful drviers, could be made a part of the regular registration plate but separated from it by a line of perforations, like the stub of a ticket. Any car having an "honor" license plate then would be marked as being safe and those without them could be watched by police and public. If, and when the careful driver was convicted of recklessness, the police officer need only reach down and rip off the "honor" plate to brand the driver as a speed demon. But there's one big loophole. Wouldn't the bad boys of the neighborhood spend many happy Saturday afternoons ripping the much cherished "honor" plates from parked cars?—L. N. D., Boston, Mass.

How Fast a Snake Runs Still a Moot Question

While Popular Science Monthly is a handy medium of high grade information there often creeps into its columns some low grade mis-information, which is to be expected. Take for example the California scientist who claims he experimented with snakes and who states the highest speed of even the famous blue racer is two and one-half miles an hour. He should stop fooling with torpid, box-raised serpents and take to the woods where many species would teach him his letters in snake-craft at the rate of twenty miles an hour. Some branches of science are indispensable and show concrete advances from time to time because bald realities are dealt with and proofs are near at hand. Others deal with fiction and theory and here the most fabulous claims are put before us by scientists. They prattle of cosmic rays, the curvature of light, relativity but none can really state what causes tornadoes or droughts or satisfactorily explain earthquakes. All of which leads us to think they are in a class with their brother who wrote on the snake question.—M. H. S. Athens, Tenn.

Gravitation Does the Trick In the Two-Tank Problem

It would appear that J.C.H. of Hart, Mich., in his question about water in two tanks, is trying to reverse gravitational direction. The direction of gravitational force on the earth is always toward its center, and hence, any object whether solid, liquid, or gaseous will move in that direction when free to do so. In this particular problem, it is of extreme importance to note that the surfaces of the water in each vessel is exposed to the atmosphere, and hence the volume of each has nothing to do with the flow. The important fact is that the water will always flow through the siphon tube toward the vessel whose exposed surface is at the lower level. The fact that the two vessels are connected by a siphon tube or are not the same size is of no importance.—H. M. Y., Matoaka, W. Va.

Do They All Know the Way Or Follow a Leader?

One hundred and thirty-seven cats were loaded into a freight car here recently when the warden of the Illinois State Penitentiary decided to have a cat housecleaning. The train puffed away and he thought he had seen the last of the yowlers. A few days later, a long string of cats, headed by a big tabby, appeared up the road, making for the prison gate. The cats had come back! Since then, I have heard half a dozen arguments about how cats come back. I wish you would explain how they find their way and also how fish, eels, and birds make long journeys and return to their starting points. I am sure such an article would be interesting.—D. K., Joliet, Ill.

Even For Us, Doomsday Is Plenty Long Enough

Ever since your magazine started to publish articles on microscopy I have been contemplating getting a microscope. So about two months ago, I bought a new microscope and accessories. Please, keep Borden Hall on your staff. He writes the best articles on microscopy that can be printed. On the whole your magazine is full of new ideas and swell shop notes along with interesting articles on chemistry and microscopy. Boosting your magazine until doomsday.—L. F. B., New York, N. Y.

Anybody Else Want to Build Miniature Circus Model?

There is one thing I can't understand about your model making department. You have all sorts of ship models, airplane models, railway models, and other kinds of models, but never a circus model. Don't you think you are missing a good bet? I go to the circus every year and always come home with the idea of building a small model of the "big top," with baggage wagons, cages, railroad cars, and everything. I never make a start, however, because I don't know enough about the mechanical details. The public never gets a look-in on the real inside workings of the circus. Why don't you have one of your model makers get the dope and build a small

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circus model that doesn't take up too much room, yet looks like the real thing? There must be thousands of circus fans who will cheer for this.—E. J. L., Hackensack, N. J.

If Mistakes Are Buried, Why Talk About Them?

DR. DAMRAU'S articles on surgery have made good reading, but they have told only one side of the story—the bright side. Of course there have been wonderful operations performed; everybody knows that. But he never said a word about the failures of the "sawbones." I will never stop believing that there is a lot of unnecessary cutting up going on in our hospitals and that most of the wonderful operations are the result of guesswork and luck. The surgeon did not know just what was the matter but he took a chance and got away with it. And if he was wrong they buried his mistake six feet under ground and nobody asked any questions. I can't believe that the doctors know so darn much about the human body, which is one of the most complicated pieces of machinery ever made, when you can't even get an automobile fixed and know for sure it is done right.—J. H. S., Tacoma, Wash.

"Impossible" Checker Problem Is Solved Just Like That

B. A., OF NEW YORK, who has a checker problem that no one can solve will have to come across with a harder one than that. If he will get out his checkerboard and arrange the pieces as he directed and follow my explanation, he will be able to solve the problem with no difficulty. First, there are six moves that must be made, otherwise you'll waste your time. Move No. 1 to No. 10; No. 4 to No. 11; No. 5 to No. 14; No. 28 to No. 19; No. 32 to No. 23; and No. 29 to No. 22. Remove all checkers jumped. From this point, you can move any way you like on the board and solve your problem every time. It is best, however, to work toward the center as much as possible, but you can't go wrong if you remember these first six moves as I have given them above and then jump always toward the center.—N. F. H., Jr., Crawfordsville, Ind.

Cayenne Pepper Was More Than His Rats Could Stand

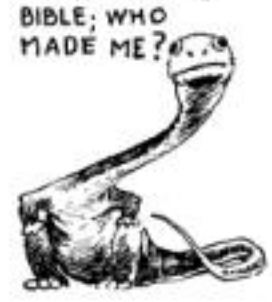
POWDERED cayenne pepper, when poured or sprinkled in liberal quantities into rat holes or in cracks or crevices in buildings infested with rats, is a cheap and effective way to rid a place of rodents. Hordes of rats got into the walls of my home, between the weatherboarding and ceiling, and became a nuisance. Poisons and traps were used, with little success. The rats ignored poisoned bait and evaded the traps. Finally, I bought a supply of powdered cayenne pepper, ripped off a few planks, and poured the pepper into the space between the weatherboarding and ceiling and into every hole in the ground on the place where rats burrowed. The pepper had an immediate effect. Every rat left in a hurry and the place has been free from rats for several years. Other people in the vicinity, learning of my use of pepper against rats, tried the same method with equal success and dismay to the rats.—W. D. R., Pass Christian, Miss.

Pure Water Collects in This Ancient Sarcophagus

SINCE you recently described the "aerial well" which my fellow-countryman, M. Knapen, has built to capture water from the atmosphere, you may be interested to hear of a curious and somewhat similar phenomenon. The ancient cloister of Arles-sur-Tech at Vallespir contains a sarcophagus dating from the fourth century. This oblong, hollowed-out stone has a loosely-fitting top of an unusual, prismatic design. Within the sarcophagus there accumulates at least 100 liters of pure water yearly. Dwellers in the region view the appearance of the water as a miracle, but there seems to be no doubt that, in reality, it is formed by natural precipitation. The odd design may contribute to the extraordinary quantity of moisture collected, and one may speculate as to whether it represents an ancient invention to furnish drinking water in a land where rainfall was scarce.—J. D., Lyon, France.

Now You Evolutionists, Please Behave Yourselves

I DON'T care how much scientific proof there is, or ever will be, in support of the statement that man descended from a monkey or any other mammal. I have read numberless books and articles by evolutionists dealing with this matter which probably prove conclusively, to some people, that such an evolution actually took place. Those who believe these arguments, and especially evolutionists who spend time and energy gathering the data, are, to my mind, nit-wits and numskulls. If, during the rest of my life, I read nothing but so-called proof of man's evolution from mammals, I'd still believe it all to be just plain bunk. Here is the reason for my belief: I have read the Bible and it says that our Lord made man. This, to my mind, banishes all thought of evolution. And if all the evolutionists in the world set before me all of their scientific proof on this matter, I'd still believe the Bible in preference to all other authority.—E. R. S., Torrington, Conn.



Save That Razor Blade With an Oiled Pad

MILLIONS of safety razor blades are thrown away before it is necessary because of the thin, almost invisible, rust that forms along the edge when not in use. This can be overcome by the following means and will greatly lengthen the life of the blade. Sterilize a strip of light felt by scorching it in the oven and then saturate it with a good grade of light machine oil. Clean the razor blade but instead of putting it back in the razor frame lay it on the oiled felt and wrap it carefully up in it. This will thoroughly protect the keen edge from rust and the oil can be quickly removed by simply rinsing it in scalding water each time before shaving. Or, if there is no hot water, the oil can be wiped off sufficiently with any soft cloth if care is taken not to injure the edge.—L. B. R., Harwich, Mass.

Old Magneto Wire Makes Fine Woven Baskets

I AM wondering if readers of POPULAR SCIENCE MONTHLY know of the beautiful things that can be made with the copper wire in an old Ford magneto? As we all know, this wire is flat and easily cleaned. It can be woven basket-fashion into small mats. Newspaper wall pockets or small baskets can be woven and put around flower pots, bottles, tin cans, square boxes, and numerous other things. Lettering can be done on them with a soldering iron. When given a coat of white shellac or varnish, they are easily cleaned.—W. T. C., Muskogee, Okla.

Java Wants to Know How Your Magazine Is Made

I WILL not join in the monthly chorus of "give us more of this" and "give us more of that." However, I hope, that sometime, the editor of our good POPULAR SCIENCE MONTHLY will print an article on the magazine itself. Tell us exactly how it is edited, compiled, printed, and bound. Tell us all of the inside story of how the magazine is produced so that we can actually see the editorial and mechanical wheels go round. I think every reader would appreciate an article of this kind and would be made to feel more intimately acquainted with the magazine.—T. W. G. H. T., Batavia, Java.

Dr. Damrau's Old Bone Theory Is Flatly Contradicted

DR. DAMRAU, in a recent issue of POPULAR SCIENCE MONTHLY, has made quite a serious error. I disagree with his statement that the bones in old people are weaker than those in young people. The older the person gets, the stronger the bones become because calcium and lime have been collecting in them for a long time.—H. H. S., New York, N. Y.

Switzerland Sends Appeal For More Aviation Dope

I READ and like every number of POPULAR SCIENCE MONTHLY. However, I am sorry that for some time past, you have not published as many articles on aviation as you formerly did. You know summer has now come to the Alps and it's darn hard to stay on the ground, even though we can climb mountains in an effort to keep on top of things.—A. H., Berne, Switzerland.

His Home-Made Microscope Gives Keen Satisfaction

C. J. S. OF CLEVELAND, may be interested in this: I built a microscope, using the finder lens from a small box camera. I then built a frame and adjusting screw from odds and ends. It will magnify plant lice to the size of a nail head and I get a lot of fun and satisfaction out of its use. Others can easily make a similar instrument that will serve all practical purposes.—J. C., Saginaw, Mich.

Making the Tides Wait For the Electrician

WHAT'S working on me now is the old, old jinx, "Harnessing the tides," I can't recall any one suggesting the idea of utilizing the enormous power, the rise and fall of the tides, to compress air, which could be used in turn to produce electrical energy. My idea of utilizing this source of power, is to produce by it, and store up, a surplus of energy, such as compressed air or electricity—in other words, make reserved power while the wind blows. I have perfected a mill that works on a horizontal plane, which I claim is ninety-five per cent efficient in its development of power.—W. M. A. S., Dallas, Texas.

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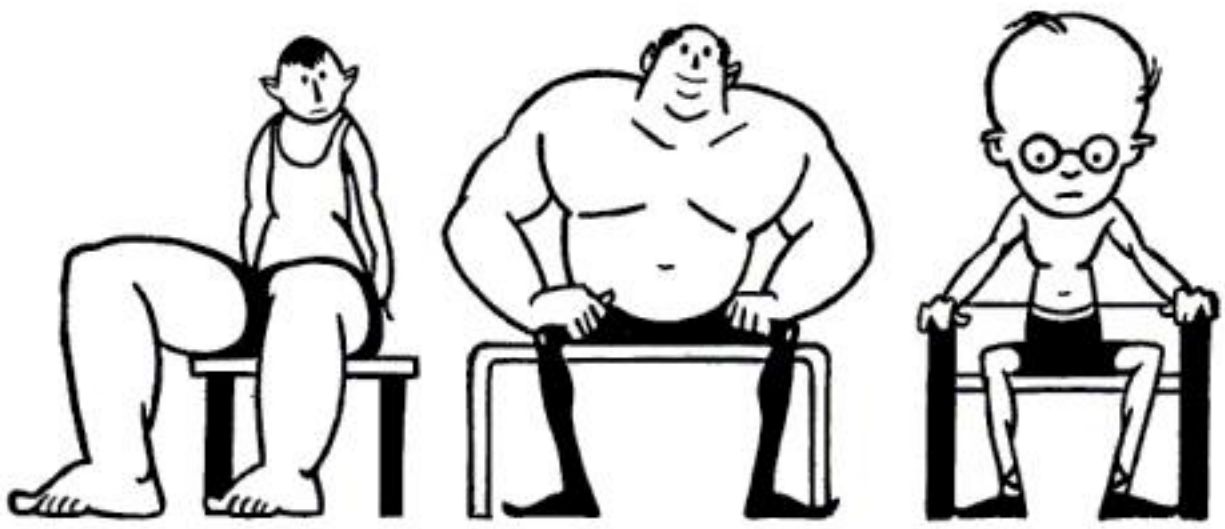
What do you mean . . .

"BALANCED VALUE"



The human individual and the motor car have one very interesting thing in common: If one faculty in a person is developed to an exaggerated degree, we say that person is *unbalanced.* He is somewhat of a freak.

The same thing is true of a motor car. No one vital part can be extended to the scientific limit without throwing the car "out of kilter."

The aim of the automobile manufacturer who serves the broad market is to design and manufacture a vehicle that will please so many people that the demand for the product will permit a price within the reach of thousands. A car answering this description might well be said to have "Balanced Value."

Readers of Popular Science Monthly will quickly recognize Pontiac's "Balanced Value" as the natural result of *balanced design* in engineering.

Back of the Performance They See the Engineering Skill and Precision

While everybody likes a good car—and gets a pleasant thrill out of driving a fine car, it is especially true of men who have the feel for machinery. They respond instinctively to the rhythm and harmony of a sweet running motor.

Men like that appreciate a car not only for what it *does,* but also for what it *is.*

It is this quality of mechanical rightness in Pontiac —the Economy Straight Eight—that appeals to readers of Popular Science Monthly.

They enjoy its thrilling performance, its easy handling, its comfort; they appreciate its economy and durability—but they get even more than this, for they sense the engineering skill, the manufacturing quality that they know *must* be there. They respond to that in a very peculiar and intimate way—respect it for its precision, its mechanical quality, the engineering technique of its Balanced Design.

Read the Free Booklet

The story of Pontiac's Balanced Design is told in a little booklet—"What do you mean—Balanced Value." It gives the operating results of balanced engineering in terms of owner benefits. You will enjoy it. Any Pontiac dealer will gladly give you a copy. Or, if you wish, send a postcard to Pontiac, Room 15-266 General Motors Building, Detroit, Mich., and we will mail you a copy. The booklet is free.

Visit the General Motors Building, Century of Progress

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POPULAR SCIENCE
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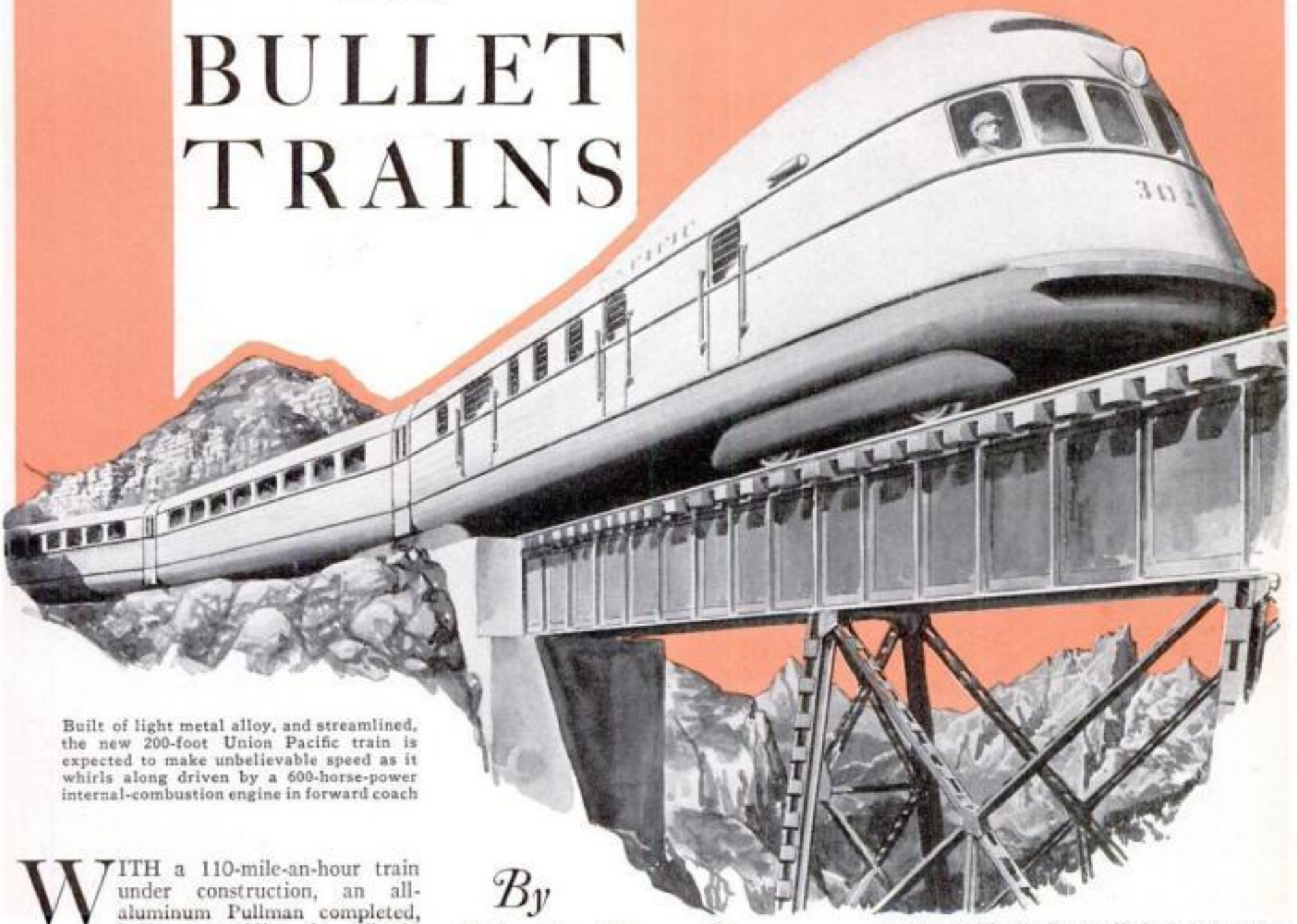
August 1933 Vol. 123, No. 2

RAYMOND J. BROWN, *Editor*

Railways' Fight for Lost Traffic Brings

Mountain-Top Road *and* BULLET TRAINS



Built of light metal alloy, and streamlined, the new 200-foot Union Pacific train is expected to make unbelievable speed as it whirls along driven by a 600-horse-power internal-combustion engine in forward coach

By
H. J. FitzGerald

WITH a 110-mile-an-hour train under construction, an all-aluminum Pullman completed, bullet cars riding the rails in France and Germany, and an amazing mountain-top roadbed ready for service in California, recent months have seen record advances in railway equipment.

The race of the railroads to regain lost traffic is on. With faster, lighter, more efficient equipment, they are cutting costs and stepping up the speed of travel.

Like a 200-foot streamlined arrow, the new-type train designed for use on the Union Pacific is expected to skim over the rails at 110 miles an hour for short periods and to maintain a mile-and-a-half-a-minute clip on straight tracks. Accommodating 119 passengers, besides mail and baggage, the three coaches of the train will form a single streamlined unit weighing no more than one present-day Pullman. It will be driven by a 600-horsepower internal-combustion engine generating electricity in the nose of the forward coach. Sealed shatter-proof windows and special air conditioning apparatus will eliminate all dust and noise.

This radically new form of rail transportation is expected to be in operation within six months. At first, it will be used between large cities along the line, later going into service on the transcontinental run.

Another super-speed rail car recently touched 115 miles an hour on a straight stretch of track near Paris, France. The single coach is driven by four 200-horsepower racing automobile engines. It carries fifty-two passengers and at top speed makes two and a half miles on a gallon

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RIGHT THROUGH MOUNTAINS

The world's first entirely machine-built railroad has been run through terrane like this, where it was necessary to fill chasms, slice off mountains and bore long tunnels through solid rock

of fuel. In the same class is a new twin-car German train which reaches 100 miles an hour between Hamburg and Berlin. At this writing, a 42-passenger Austrian rail car, which has a combination of pneumatic tires and standard railway wheels and is capable of 90-mile-an-hour speeds, has been shipped across the Atlantic and is being tested on the Long Island Railroad, in New York.

Behind another railway innovation, the all-aluminum Pullman now on exhibit at the Chicago World's Fair, lie almost three years of constant research. Even the trucks of this huge observation car are cast of solid aluminum. As a result, it weighs half as much as a conventional sleeper. Thermostatic control automatically governs the temperature within the car, warming the filtered air in winter and cooling it in summer.

The most dramatic of recent railroad advances, however, is an epic of modern engineering written by men and machines in the mountains of northern California.

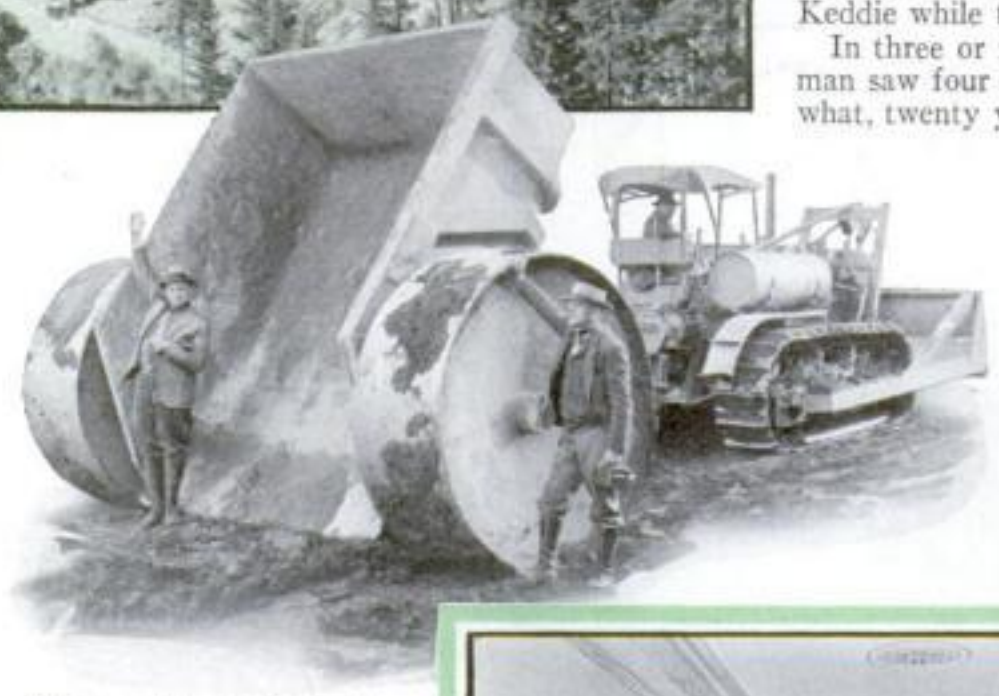
A mile above sea level, and running virtually along the tops of the Sierra and Cascade ranges for more than 100 miles, is the world's first mountain-top railroad. To build it, engineers sliced off peaks, filled in chasms, bridged gaps with trestles twenty stories high. An extension of the Western Pacific, running northward from Bieber, Calif., to Keddie, near the Oregon line, it represents the first time in railroad history that engineers have dared conceive such a project much less seriously recommend it as physically and economically possible.

Yet it was built in record time and at record low cost, and its heaviest grade is only 2.2 per cent. All these things are due to the fact that, unlike any other major railroad in history, it was built almost entirely by machines.

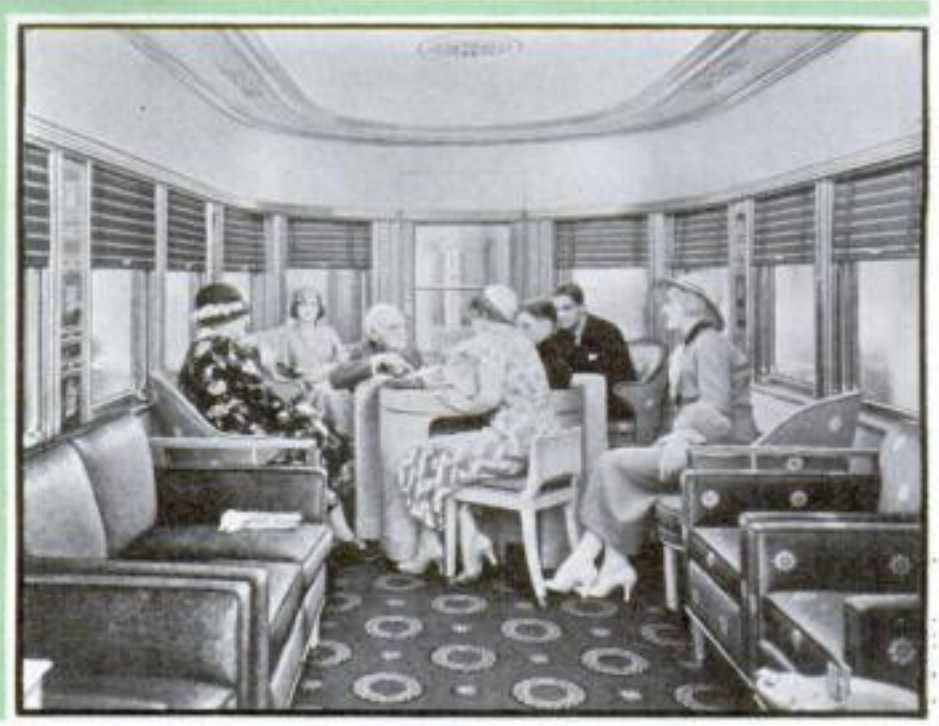
Until work on this line began there had been for more than 100 years one traditional, orthodox way of building a railroad. That was to put several thousand men to work with horses, mules, plows, scrapers, picks, shovels, hand drills, sledge hammers, and black powder and keep them at it for several years. It was after this fashion that all the eastern roads were built, that the Central Pacific crossed the Rockies, and that the West's last previous big construction job was handled when the Western Pacific came through from Salt Lake. Which accounts for the amazement of a sunburned man who walked into a contractor's shack at Keddie while the work was in progress.

In three or four minutes the sunburned man saw four men and three machines do what, twenty years ago, would have taken thirty or forty laborers, fifty mules, and twenty-five scrapers two hours of hard work to do.

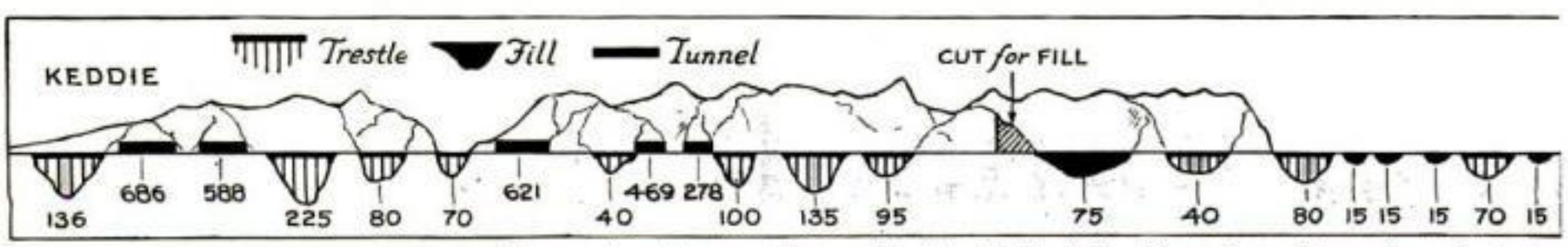
"I'll be doggoned!" he exclaimed. "I'm glad



Twelve cubic yards of rock and dirt are carted away at one time with this tractor-drawn railroad dump cart



Interior view of the new all-aluminum Pullman car which weighs only half as much as the ordinary sleeper. Designed after extensive research, the car is on exhibit at the Chicago Fair



Cross section of the mountain-top railroad bed, built wholly with machines. The numbers refer to the

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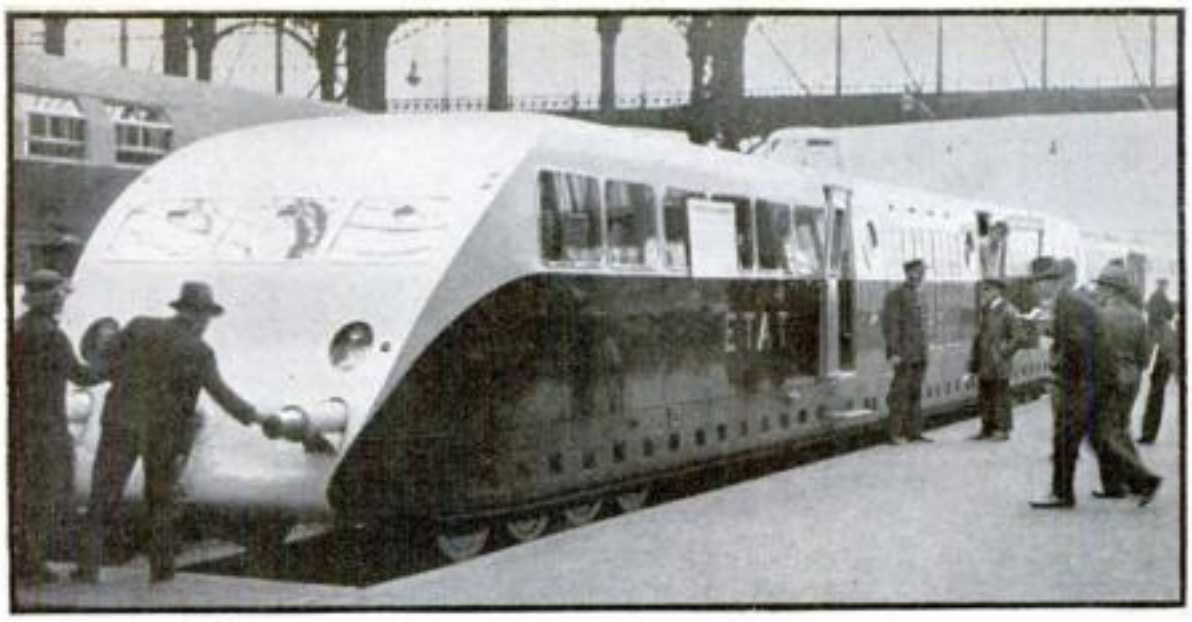
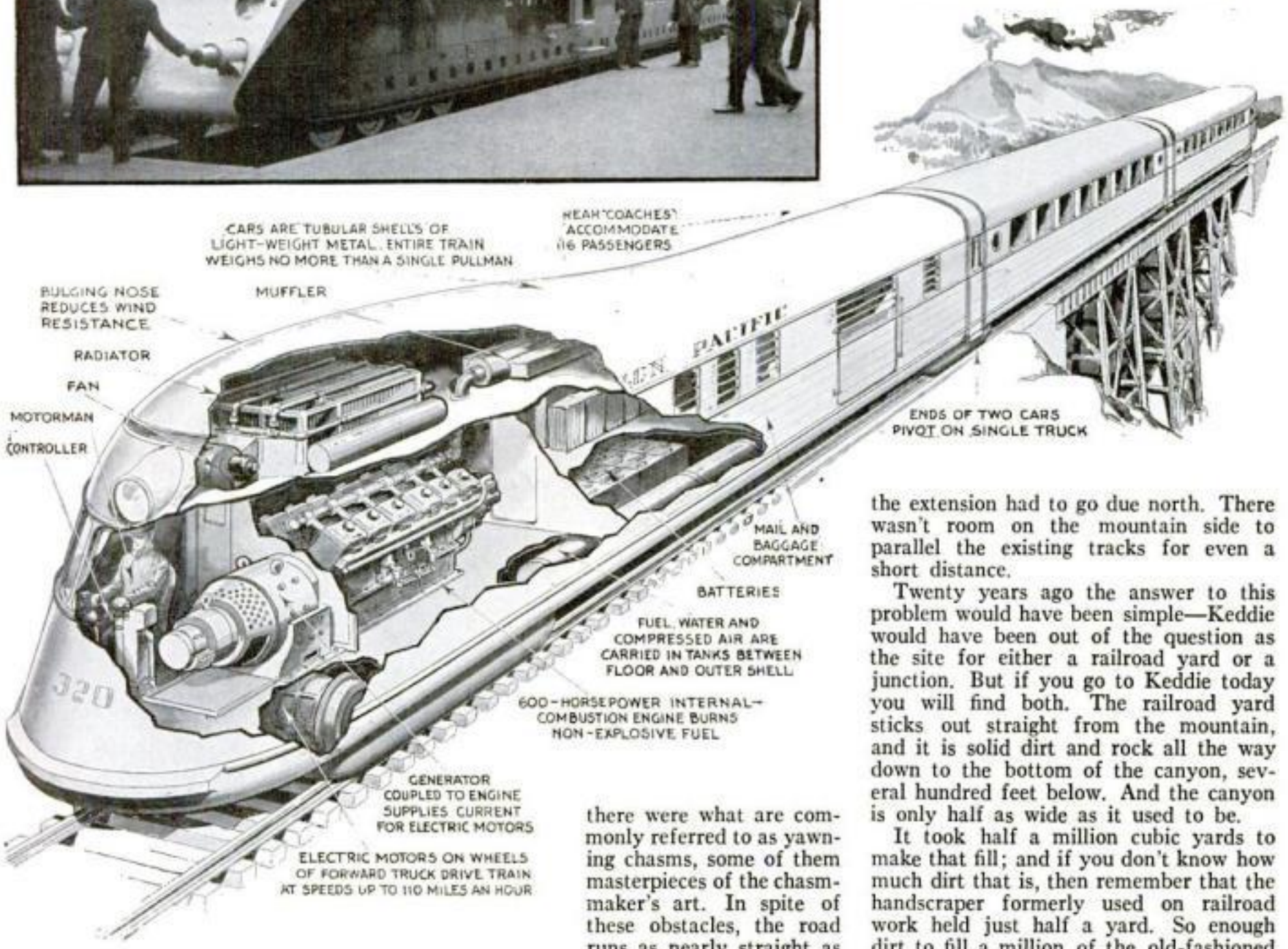


AUTO ENGINES POWER TRAIN

The French coach, left, recently ran at a speed of 115 miles on tracks near Paris. It is powered with four 200-horsepower racing-automobile engines. It carries fifty-two passengers and makes two and a half miles on a gallon of fuel. Below, drawing shows the 600-horsepower internal-combustion engine as it is installed in the new Union Pacific aluminum, streamlined train



I dropped around in time to see the first railroad in the world that wasn't built by the power of mules!"

Machines have made it possible to run lines where it was impracticable, if not actually impossible, to run them before. In pick and shovel days, mountains were important obstacles. Railroads had to follow the passes and river courses or run into heavy grades and prohibitive costs. A route across a mountain range looked like a child's first efforts to write.

The prevailing topography of the country north from Keddie is, roughly speaking, straight up and down. When there weren't mountains in the way of the line, there were what are commonly referred to as yawning chasms, some of them masterpieces of the chasm-maker's art. In spite of these obstacles, the road runs as nearly straight as many of those built close to sea level on fairly smooth terrane.

At the height of a mile, a road that tries to go straight and maintain a fairly horizontal position runs smack into one problem after another that would have baffled solution in the old mule-and-scraper days. This was the case at Keddie, where the extension takes off from the main line of the Western Pacific.

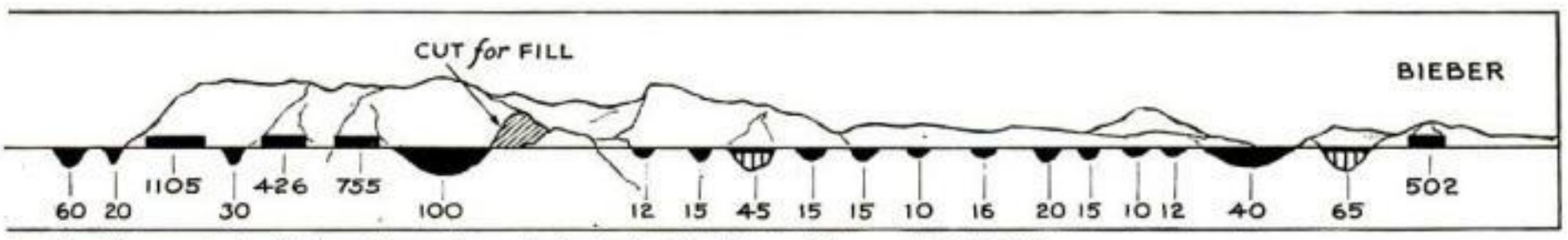
It was necessary to establish a junction there, and also a railroad yard. This seems simple enough until you look at Keddie. The town is half way up the side of a mountain promontory that sticks out into a couple of deep canyons. It is on the south side of the mountain and the extension had to go due north. There wasn't room on the mountain side to parallel the existing tracks for even a short distance.

Twenty years ago the answer to this problem would have been simple—Keddie would have been out of the question as the site for either a railroad yard or a junction. But if you go to Keddie today you will find both. The railroad yard sticks out straight from the mountain, and it is solid dirt and rock all the way down to the bottom of the canyon, several hundred feet below. And the canyon is only half as wide as it used to be.

It took half a million cubic yards to make that fill; and if you don't know how much dirt that is, then remember that the handscraper formerly used on railroad work held just half a yard. So enough dirt to fill a million of the old-fashioned scrapers was taken out of the mountainside and dumped into the canyon.

At Sheep Camp Gulch, the proposed line crossed a canyon and then pointed at the adjacent mountain. A ten-story building standing on the canyon bottom would just have reached to where the road was to cross, and a twelve-story building on top of that would just have permitted an observer on its roof to peak over the mountain top. The railroad builders, taking note of this situation, took off the top of the mountain and filled the canyon with it, bringing both to the same level.

The 110-foot fill not only overtops the tallest trees in the canyon, but it also overtops by a *(Continued on page 95)*



length of the tunnels, the height of the trestles, and the depth of the fills on this recently finished line

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Armored Horned Toad

BIGGER THAN AN Elephant

Barnum Brown, of the American Museum, removing the fossil skeleton of an armored dinosaur that roamed the plains of Montana more than 100,000,000 years ago

By Edwin Teale

EMERGING from blocks of sandstone at the American Museum of Natural History, in New York City, the most perfect dinosaur fossil ever discovered is telling a thrilling, hitherto unknown story of a new type of prehistoric monster, a super dreadnaught creature of 130 million years ago.

Imagine a horned toad twice the size of a hippopotamus! That is the fantastic picture conjured up by the remains of this giant, discovered recently in Montana by Barnum Brown, curator of fossil reptiles at the museum. Because of the hardness of the rock, it will be months, perhaps a year, before the work of chipping away the grains of sandstone is completed. But the early stages of the task have already brought to light a remarkable discovery.

Underneath the skin of the Montana monster, there appears a secondary layer of armor, suggesting the coat of mail worn by a Knight of the Round Table. It is composed of small bony plates set close together. These plates are like miniature reproductions of the huge bucklers of bone which form the main armor along the back and sides of the great reptile. The coat-of-mail plates are found most frequently around the neck and at other points where bodily movements would produce slight gaps in the massive outer plates of bone. The teeth and claws of enemies were thus prevented from gaining entrance through such cracks in the creature's armor.

Thus, for the first time, science has learned of a double-armored reptile of the past. Other revelations, as the work progresses, are expected to fill in gaps in our understanding of how these and other walking fortresses of 130 million years ago were formed and how they lived.

The discovery of the fossil giant, considered one of the most important in recent years, was made last winter during an expedition to the bad lands of southern Montana. A fragment of bone, a section of one of the rib plates of the monster, had washed down from the side of a cliff. It was this clue which led the scientist to his find. He followed the dry bed of the rivulet and came upon the remains of the dinosaur, fully eighteen feet long, locked in solid sandstone.

There followed a month-long battle with the elements. Hardly had the discovery been made when a blizzard closed in with an eight-inch fall of snow. The expedition erected a tent over the rocks containing the fossilized monster and continued its work. Day after day, with the temperature dropping below zero, they labored with whisk brooms, wire screens, and a special fossil-hunting pick designed by the leader.

The tent was heated by only a metal lantern. At times it was so cold it was impossible to cover the extracted pieces of rock with a protective coating of plaster of Paris. The plaster froze and disintegrated. For less than two hours at midday was it warm enough to do the plastering work and then the hardening material had to be covered quickly with blankets to prevent freezing. During the month four blizzards swept across the bad lands, cutting off communication and increasing the difficulty of the work.

Finally the rock was cut into thirty-five separate blocks, carefully numbered to aid in assembling the skeleton, and packed in heavy wooden cases. The tons of sandstone, and the bones it contained,

Rocks containing the parts of the dinosaur's skeleton were numbered with paint and this photo taken. It will serve as a guide in correctly mounting the bones at the museum

• STRANGEST PREHISTORIC MONSTER DUG FROM MONTANA

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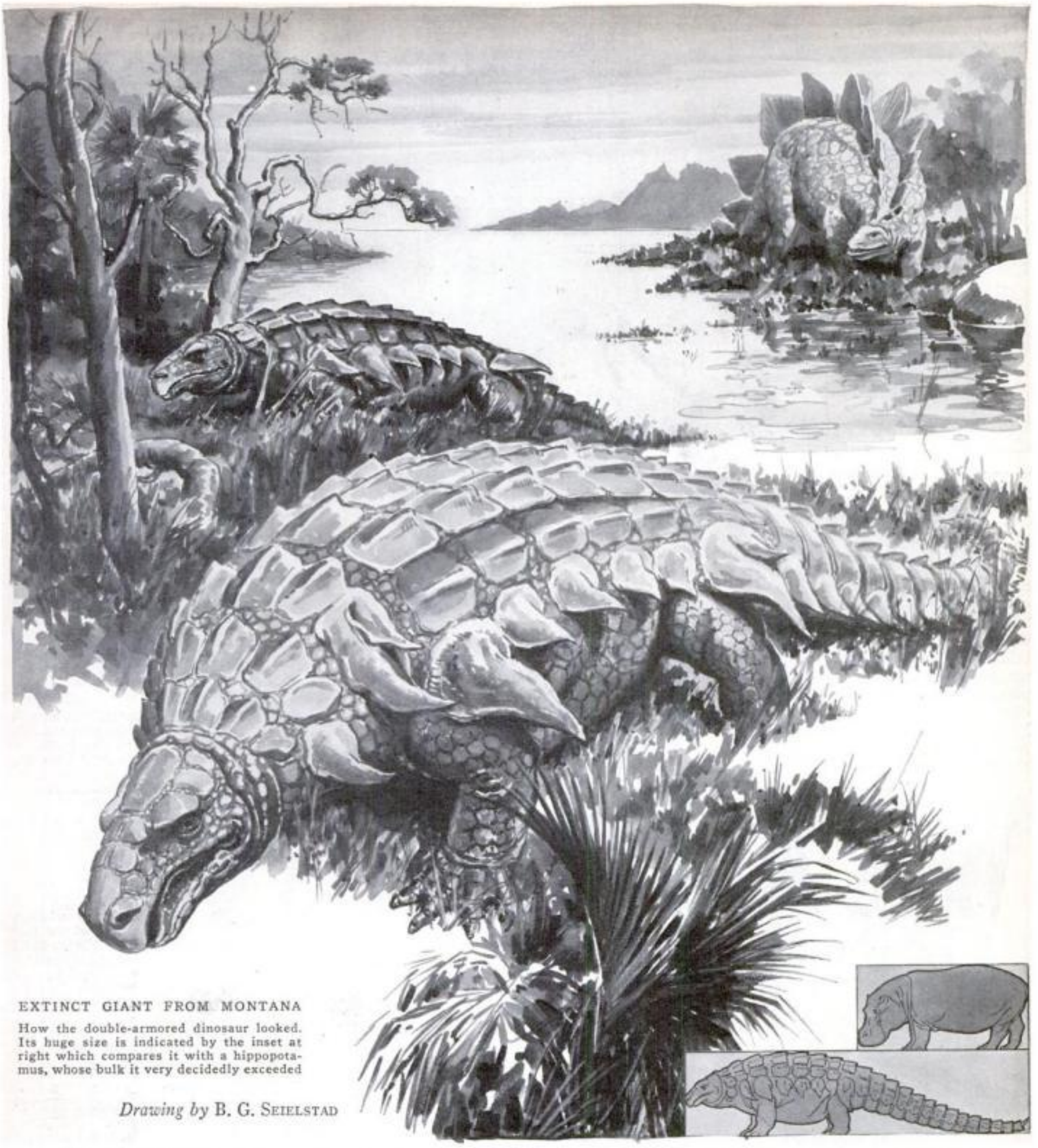

EXTINCT GIANT FROM MONTANA

How the double-armored dinosaur looked. Its huge size is indicated by the inset at right which compares it with a hippopotamus, whose bulk it very decidedly exceeded

Drawing by B. G. SEIELSTAD

were then shipped East. And now the painstaking work of chipping away the hard quartz grains is going forward. During this process of extracting the fossil bones, they are soaked repeatedly with shellac and other hardening materials to prevent their crumbling away when the rock is removed.

As the scientist pictures the scene, the sandstone cliff was once the shore of some prehistoric sea. The great reptile apparently met its death on the beach and was caught and covered by the shifting sands. This happened suddenly, it is believed, so that the skin plates and the bones of the internal skeleton were kept together and preserved as the sand hardened into stone. Added support is given to this theory by the fact that shell fragments, the teeth of alligators, parts of prehistoric turtles, and bits of broad-bladed, primeval rushes were embedded in the rock beneath the fossil monster.

As a result of this prehistoric tragedy, science is being given the clearest picture of an ancient armored reptile yet obtained. Usually the great plates and spines associated with a fossil skeleton are found so jumbled and heaped together that putting them in order is admittedly guesswork. Gaps have to be filled in and the scientist is never positive he is right about these vanished creatures.

But in the case of the new and as yet unnamed find, the plates are practically intact except for the head. Already, the laboratory work has progressed far enough for us to visualize the shape and size of this huge creature of a lost world.

It moved slowly on broad, heavy legs, dragging its enormous body through the rank vegetation of swamps and shallow seas. The head was flat, triangular, equipped with a horny beak like that of a turtle, with which the monster nipped off the plant food upon which it lived. Its body was covered from head to tail with thick *(Continued on page 78)*

ROCK PROVES MOST SENSATIONAL FIND IN YEARS •

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FALLS THREE MILES WITH 'CHUTE CLOSED

LOOK at the second hand of your watch moving around the dial, until it registers one minute and twenty-five seconds—and try to imagine plunging head over heels toward the earth for that length of time! This was the recent feat of John Tranum, dare-devil parachute jumper, when he leaped from a plane flying four miles above a British air field. Opening his 'chute only 3,500 feet from the ground, he swung safely to earth with a new delayed parachute-opening record.

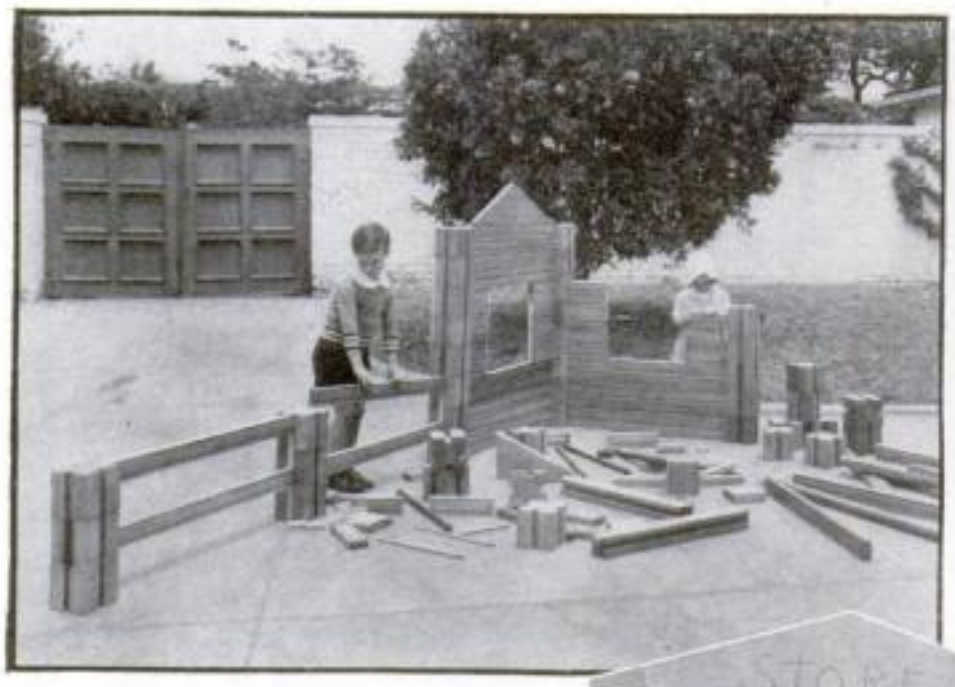
At upper right, how parachute jumper leaves the plane four miles above the earth. At upper left, examining the watch that timed the long fall with closed 'chute

VIOLIN HOOKED TO RADIO SET

STRINGED instruments without sounding boards, including violins, cellos, guitars, and ukuleles, have been devised by an eastern violin maker. Vibrations of the strings pass through the bridge to a magnetic pick-up, resembling a microphone, that converts them into electric currents. These are amplified to operate a loudspeaker. At home the instruments may be plugged directly into the family radio. One of the new violins is illustrated above.

CAT PICTURES USED TO SCARE AWAY BIRDS

IF LIVE cats will scare birds away, why not use imitation cats as scarecrows? Acting on this unconventional idea, a farmer of Warwickshire, England, is decorating his property with painted likenesses of cats like those illustrated above. Stoppers from mineral water bottles supplied the eyes. Now it remains to be seen whether the birds will be terrified.



A house, large enough for the young builders to play in, is being erected with big building blocks. Dovetail joints fasten the blocks together without use of nails

The play-store, below, was built of the new monster blocks. Child standing in front of it gives idea of its size

MONSTER BLOCKS FOR PLAYHOUSES

YOUNGSTERS may construct real playhouses and full-size, serviceable pieces of furniture with a set of giant building blocks introduced by a California toy manufacturer. Made of wood, the blocks include cubes and flat rails in a variety of sizes. A clever dovetail interlocking system makes it possible to assemble them securely without nails, screws, or glue. Whenever the fancy strikes the young architects, they can build a different structure.

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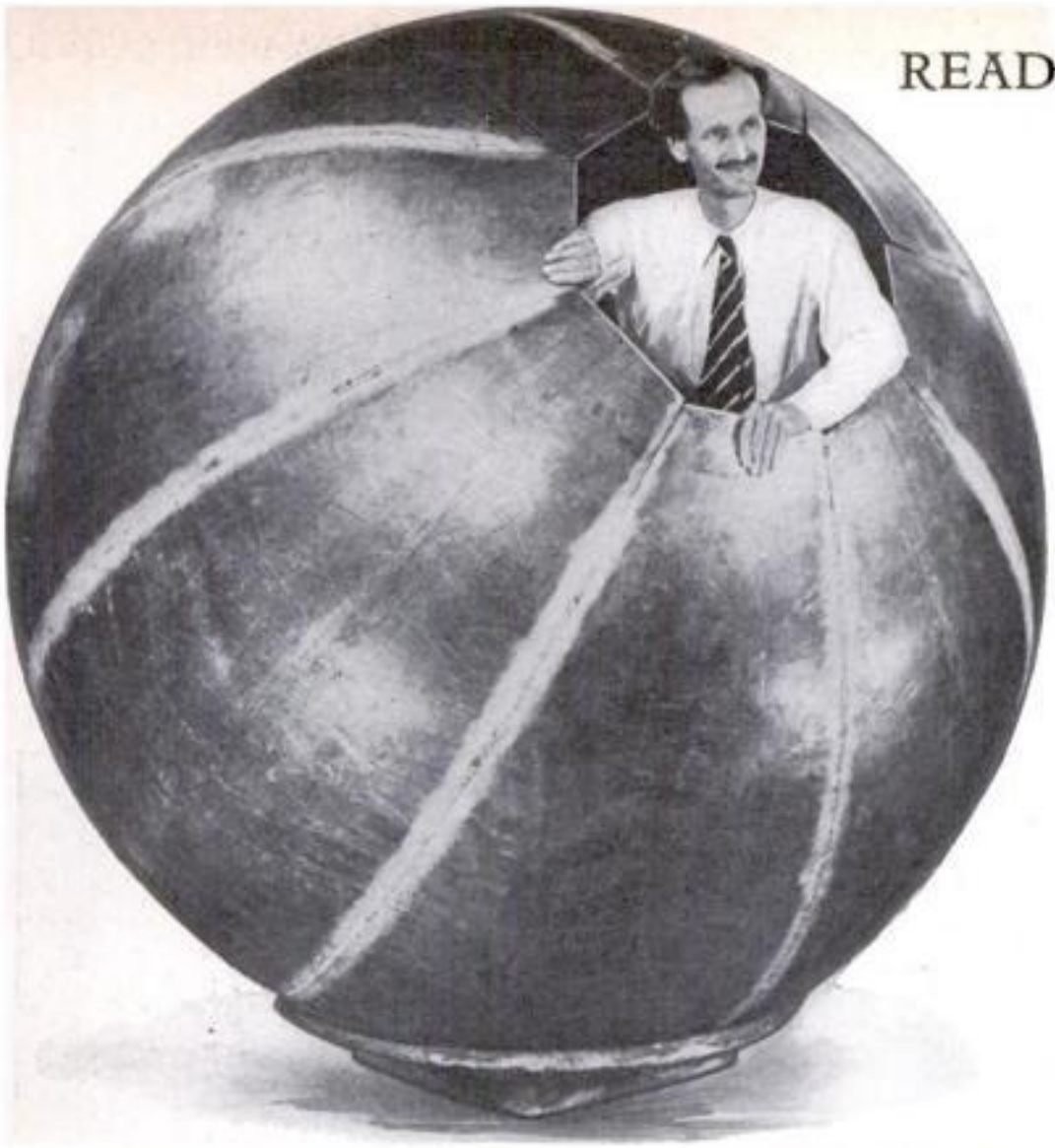
READY FOR STRATOSPHERE HOP

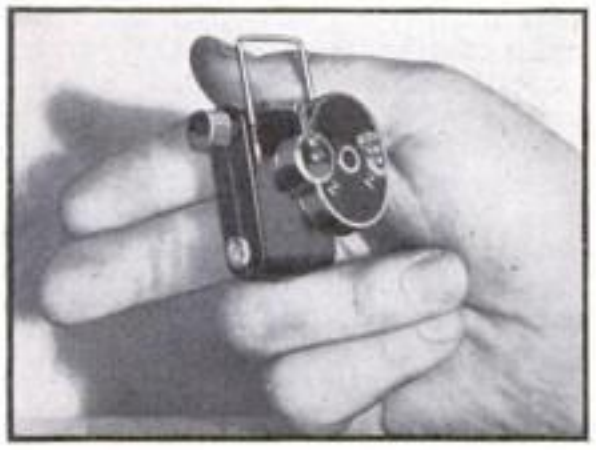


Professor Piccard, of stratosphere fame, is examining the airtight globe that will carry instruments into the air eleven miles above Chicago during the World's Fair

DESIGNED to make possible the exploration of the atmosphere eleven miles above Chicago, Ill., as a feature of the World's Fair, an airtight globe of unusual construction received its finishing touches in a Michigan factory a few weeks ago. To save weight, it was constructed of an alloy of magnesium metal that is one-third lighter than aluminum. Curved sections, resembling orange peelings, were welded together to form an hermetically sealed chamber to be carried aloft by a huge balloon. Prof. Auguste Piccard, noted explorer of the stratosphere, arranged apparatus within the globe for the measurement of cosmic rays.

ENAMEL STICKS TO BARE METAL

A NEW fast-drying pyroxylin enamel gives a one-coat finish to bare metal. It is intended for application by spraying or dipping. Cost of finishing metal articles is reduced by the new enamel as it requires no primer or undercoater. The material is dry enough to handle in an hour. The coating adheres tightly to the metal and is flexible so that bending will not crack it. The new enamel can be used to advantage in the home and home workshop.



TWO-OUNCE CAMERA TAKES EIGHT PHOTOS

A PYGMY camera, hardly larger than a golf ball, has been put upon the market in New York City. It weighs less than two ounces, and carries sufficient sixteen-millimeter film, the size used in amateur moving picture cameras, to take eight exposures. The camera's size can be noted in the picture above.

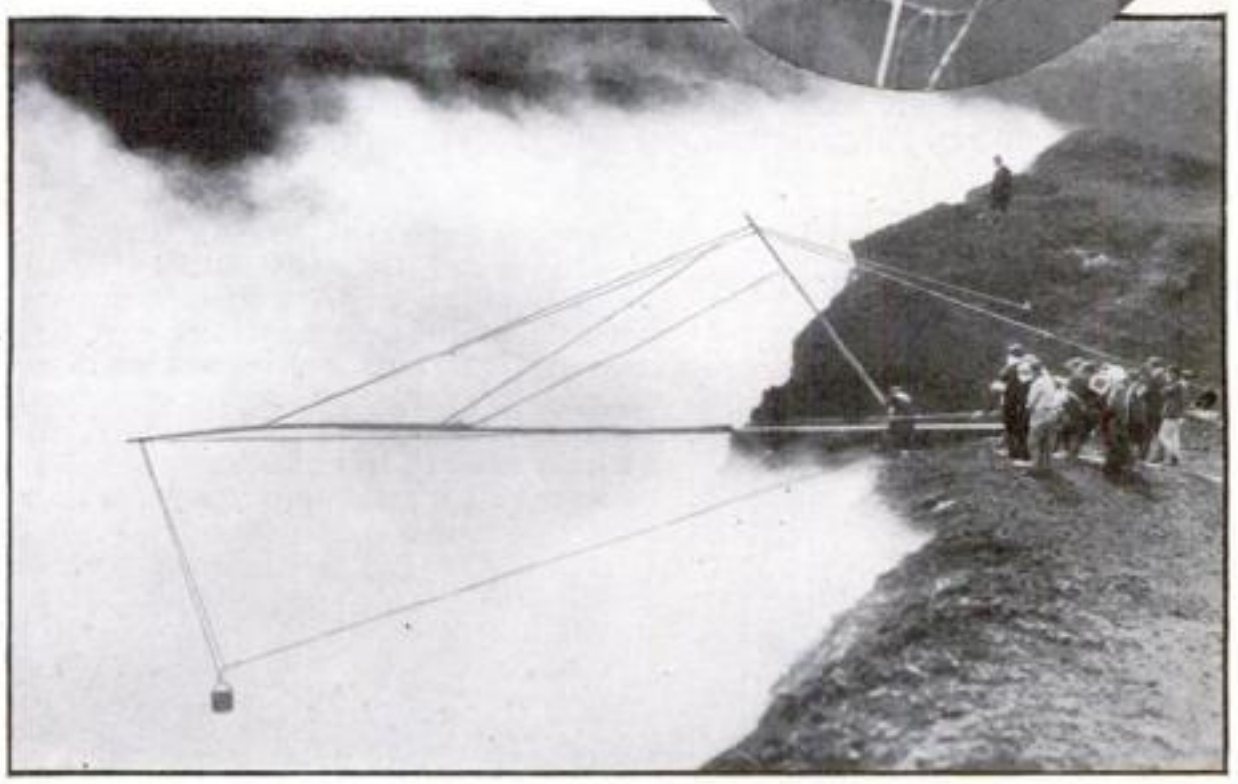
EYEGLASS IN TWEEZERS

EQUIPPED with a built-in magnifying glass, the tweezers illustrated here make it easy to thread a needle or to do other delicate work. They may be used to pull threads in fancy work, remove a splinter from a finger, or to aid in assembling fine parts such as screws in cameras.

A magnifying glass set in these tweezers enables the user to do delicate jobs easily

PLAN TO INVADE ACTIVE VOLCANO

DESCENDING into the active volcano Yomiuri, Japanese scientists plan to make close-range observations of the fuming crater. According to their daring scheme, they will be let down within an asbestos-lined box of metal. To test their chances of returning alive from this perilous enterprise, they recently lowered live guinea pigs, rabbits, and monkeys to the crater bottom in boxes of similar construction. This was done by means of a boom and framework installed on the rim of the crater, manipulated at a safe distance from the pit. The animals were unharmed.



An asbestos-lined metal box, seen in circle, is being lowered, above, into a volcano

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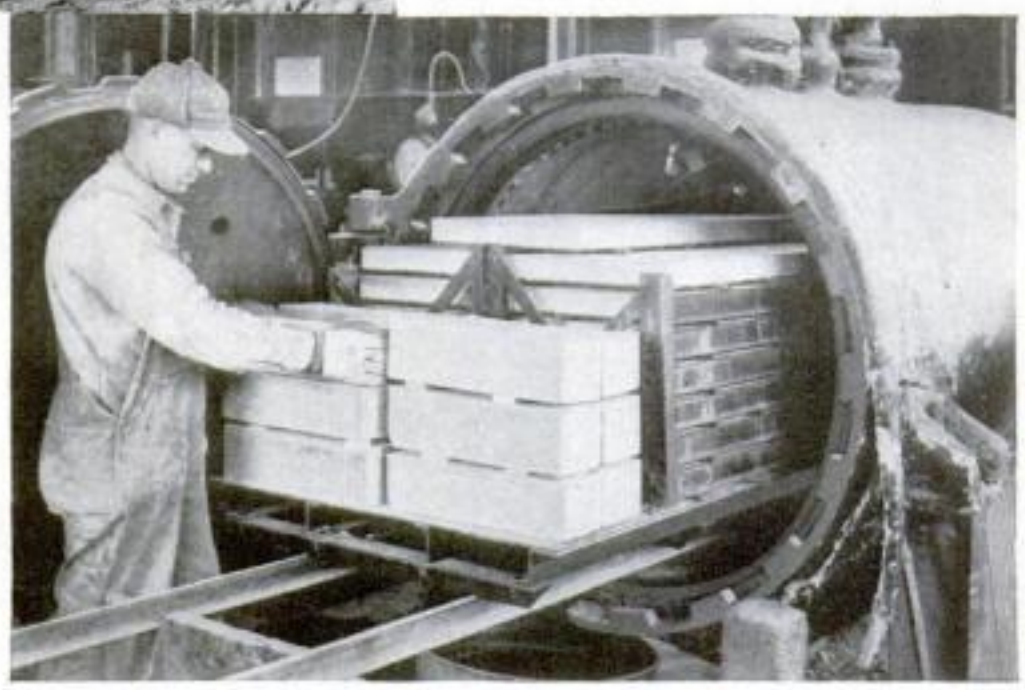
STONE FOR HOUSES MADE OF SHALE

The synthetic building stone is turned out in slabs which are assembled to form dwelling's walls

From a shale bed like the one seen above, material is obtained for the new synthetic stone



Into the autoclave, right, powdered rock in molds enters and is subjected to a steam bath that turns it into stone

SYNTHETIC stone that excels nature's product for building durable, low-cost dwellings is the recent reward of eight years of research by Purdue University engineers. Manufactured in interlocking slabs that are quickly assembled on a steel frame, it is expected to make over present-day construction methods. The raw material is cheap shale, which crumbles so easily that it has hitherto been considered worthless. Pulverized, mixed with slaked lime, and compressed in flat molds, it then receives a two-hour steam bath. A chemical reaction takes place between the shale and the lime, yielding a solid stone of unusual strength and resistance to weather. Metal bolts, suitably spaced, are embedded in the slabs at the time of manufacture. These enable them to be bolted readily into place to form both exterior and interior walls of a house. Bricks, flooring, decorative tile, and even vases and lamps may also be molded from the synthetic material.

SELF-SERVICE RESCUE STATIONS GUARD BATHERS

TO GUARD the lives of bathers in Green Lake, within a populous residential district of Seattle, Wash., eight self-service rescue stations have just been erected near the water's edge. Each contains a fully-equipped lifeboat which any citizen may launch if he sees a swimmer in distress. Opening the doors, as illustrated, automatically sets off a siren, flashes signal lights at the top of a pole, and turns in a police alarm.

A new sprayer that attaches to garden hose is demonstrated here. Below, the open mixing chamber ready for insecticide

INSECTICIDE SPRAYER FITS GARDEN HOSE

RELIEVING the home gardener of the burden of a heavy spraying tank, a new sprayer fits on ordinary hose. It uses insecticide prepared in the form of a solid brick of paddle-wheel shape, which is slipped over a pin in the mixing chamber. When the handle is pulled, a jet of water spurts into the chamber, spinning the wheel and dissolving the brick at the proper rate to give a solution of the desired strength. The mixed fluid issues from a nozzle that may be adjusted for a fine or coarse spray. The sprayer may also be used with fertilizer.

AUTO DEVICE SERVES LIGHTED CIGARETTE

SERVING a driver a lighted cigarette, a new combination cigarette case and lighter clamps upon the steering column, and is operated by turning a knurled knob. This drops a cigarette into a receptacle and turns on an electric lighter in contact with one end. After counting five, the motorist releases the knob, thus shutting off the current, and finds the lighted cigarette ready and waiting for him.

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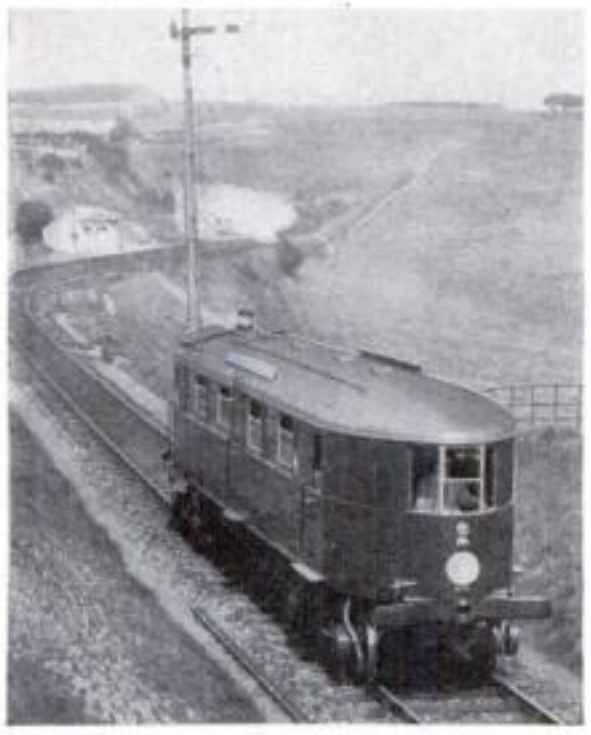
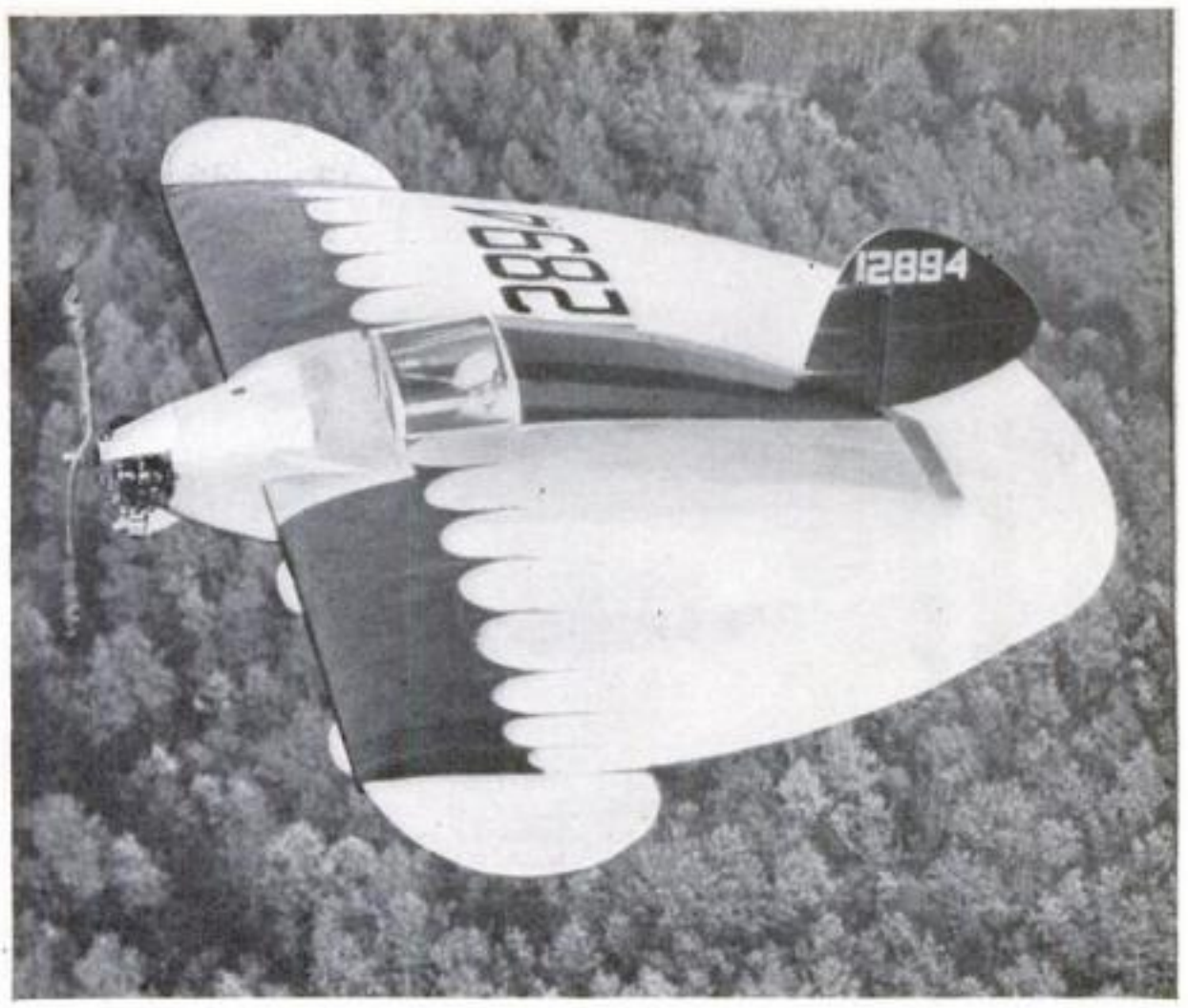
STEAM ENGINE POWERS UNUSUAL RAIL BUS

STEAM drives an unusual type of rail bus that has just been put into service in England. Its 100-horsepower engine is fired by an automatic stoker, and may be operated from a control cab at either end of the vehicle. The bus accommodates forty persons, and in trial runs has shown a speed of more than a mile a minute. It operates between Brighton and Devil's Dyke which are about three miles apart.



England's new rail bus which is driven by a 100-horsepower steam engine at a mile a minute

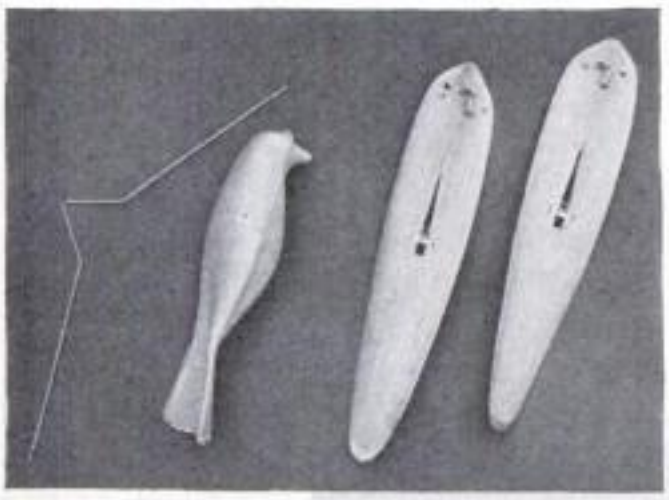


SEMI-CIRCULAR PLANE FLIES IN TEST

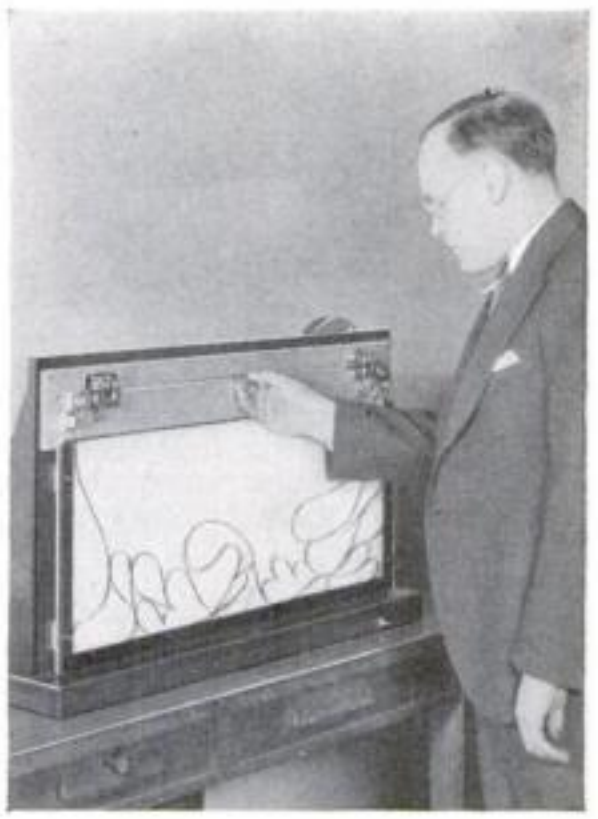
ARMY and navy officials saw a remarkable airplane, shaped like a half-slice of pie, make its first successful test flights over South Bend, Ind., the other day. The semicircular plane is said by its inventor, Cloyd L. Snyder, to combine the advantages of the autogiro with those of conventional aircraft. His machine lands in a restricted area at a speed of only twenty-three miles an hour, although it attains ninety-seven miles an hour in the air. The photograph above shows it in flight.

NEW KITE FLIES LIKE A BIRD

SHAPED like a bird and flown like a kite, a new kind of aerial toy has made its appearance on the Pacific coast. When the knocked-down wings and body of molded buckram are assembled and made fast to a line, the imitation bird is launched into the breeze with a fish pole. The wings, exactly balanced, revolve on bearings; and the bird soars and dips in the wind as if it were endowed with life. Besides providing entertainment for children, the device is said to have practical uses. Hunters use the toy to train bird dogs in retrieving, as illustrated, since it flutters realistically to earth. In a variant of this method, the bird is attached to a balloon and the sportsman brings it down by shooting the balloon.



At upper left is a new kite that soars and dips like a bird. Above, it is being used by sportsmen as a target and to train dogs to retrieve fallen birds



MAGNETS TOSS VOICE BACK LIKE AN ECHO

WHEN a World's Fair visitor speaks into the device shown above, an electric echo throws back his words after a pre-set interval up to several minutes. One set of magnets impresses the voice on a moving steel tape, and a second set picks it up. The effect sounds like an echo from a cliff, but undistorted and amplified. Delayed speech is useful in transatlantic radiotelephony, where a speaker's reply is held up in transit to give relays time to close.

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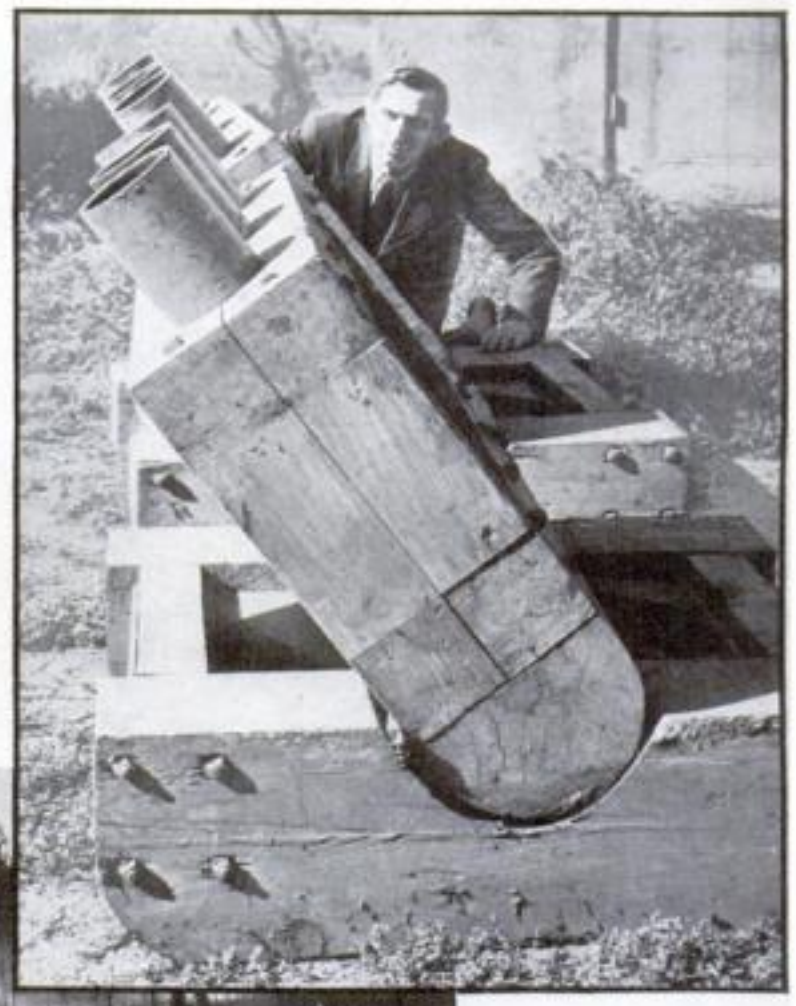
One Man Fights Wars

TO THRILL MOVIE FANS

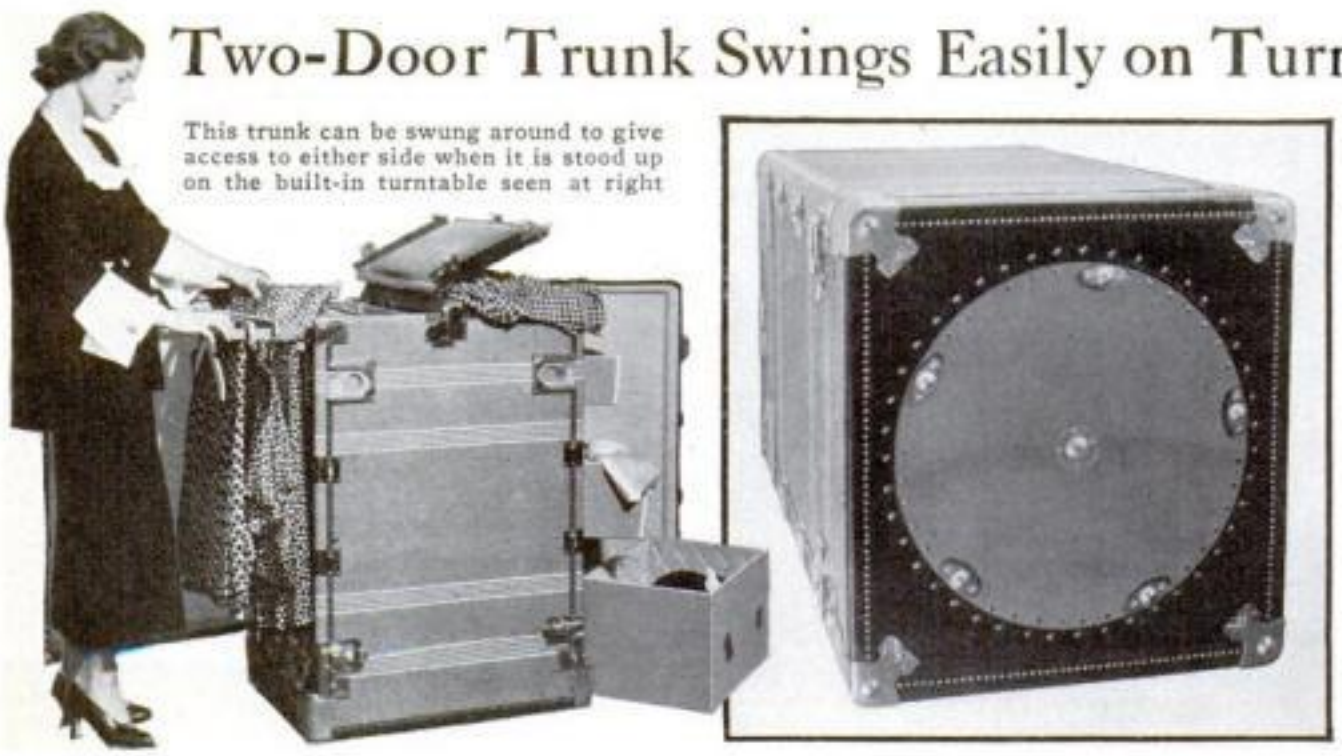


Harry Redmond and his war board by means of which he makes realistic war for the movies. The swinging handle sets off a series of small explosions, while switches fire the big ones

HOMEMADE cannon and a simple switchboard enable one man to create spectacular wars for the movies. Harry Redmond, California technician who has spotted high explosives and aerial bombs among 25,000 soldiers in a dozen film dramas, mows down troops with machine-gun bullets and wipes out whole companies with fourteen-inch shells, yet not one movie soldier has he injured. Redmond does all his work while standing beside the cameras. A war board, consisting of a panel on which are placed electrical contacts leading to buried explosives, and six short lengths of large water pipe fixed to heavy wooden bases, constitute his principal controls and armament. From the pipes, closed at the lower end, he fires bombs containing a propelling charge and time fuse. He has fired as many as 5,000 rounds in a single battle from his control board and has chased entire squadrons of airplanes through the air with papier-mâché shells from his cannon, which are set at angles so that the exploding shells will follow a plane. When troops advance in a Hollywood battle, Redmond explodes mines and shells from his memory of where the bombs have been buried. All these are placed in shallow, rounded holes. Thus the explosion goes straight up, permitting the sawdust and wood to fall in a shower on the soldiers.

With this battery of anti-aircraft guns, consisting of large pipes set in wooden bases, Redmond puts on air fights for the movies. At left, a battlefield swept with shells from Redmond's mimic war machines

Two-Door Trunk Swings Easily on Turntable Built in End



This trunk can be swung around to give access to either side when it is stood up on the built-in turntable seen at right

STRUGGLING to turn a heavy trunk around and get at its contents, in the limited quarters of a closet or a steamer stateroom, is a nuisance that is ended by a new invention in luggage—an ingenious wardrobe trunk, just placed upon the market, that spins easily upon a turntable built into its base. A touch is sufficient to turn it and allow access to drawers on one side or to a rack of clothes hangers on the other. Each side is provided with an individual door that may be opened without catching in a rug, since it swings clear of the floor. Both doors may be locked and the turntable does not interfere with the transportation of the trunk.

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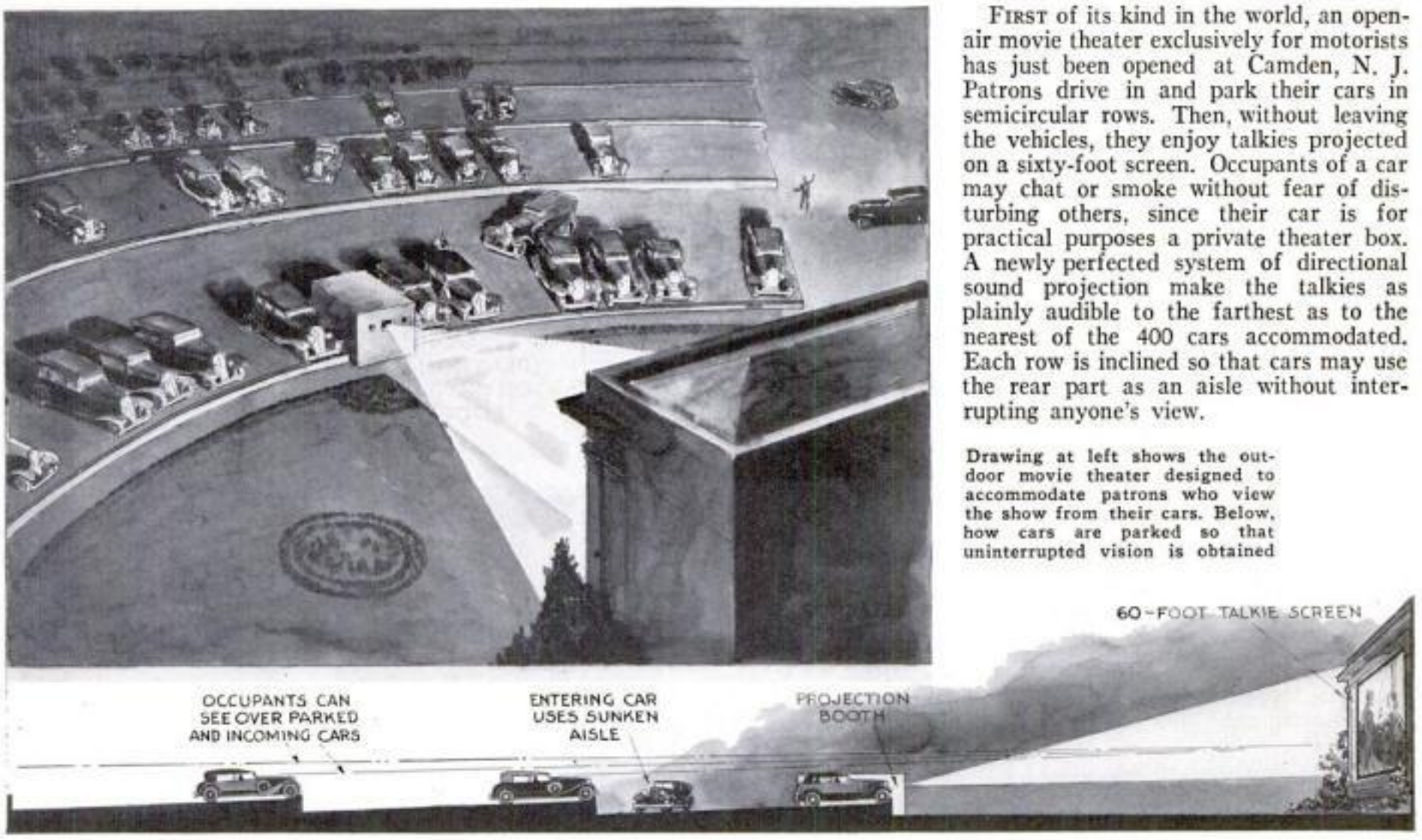
Movie Theater Lets Cars Drive Right In



FIRST of its kind in the world, an open-air movie theater exclusively for motorists has just been opened at Camden, N. J. Patrons drive in and park their cars in semicircular rows. Then, without leaving the vehicles, they enjoy talkies projected on a sixty-foot screen. Occupants of a car may chat or smoke without fear of disturbing others, since their car is for practical purposes a private theater box. A newly perfected system of directional sound projection make the talkies as plainly audible to the farthest as to the nearest of the 400 cars accommodated. Each row is inclined so that cars may use the rear part as an aisle without interrupting anyone's view.

Drawing at left shows the outdoor movie theater designed to accommodate patrons who view the show from their cars. Below, how cars are parked so that uninterrupted vision is obtained

NEW GOGGLES HAVE TRANSPARENT SIDES

A NEW style of goggles with transparent cups enables the wearer to look sideways as well as forward, removing the feeling of wearing blinders and the temptation to risk eye injury by leaving the goggles off. The unbreakable cups are large enough to be used over spectacles, as illustrated, avoiding the need of a special type for workers who wear glasses.

Goggles' transparent cups permit side view

Stovepipes worn as leggings protect men from rattlesnakes

STOVEPIPE PANTS SAVE FISHERMEN FROM SNAKES

SO RICHLY stocked with fish is the Deschutes River, in central Oregon, that sportsmen facetiously say one must hide behind a tree to bait a hook. Unhappily, the region also abounds in rattlesnakes. To invade this angler's paradise in safety, fishermen have adopted the ingenious expedient of donning tin pants fashioned from stovepipes, as seen in the photograph at the left. The metal leggings are reported to have proved successful in protecting the fishermen from the fangs of rattlers.

MACHINE "ROLLS UP" AIR TO COMPRESS IT

A ROTARY machine, invented by J. M. Holmes at the California Institute of Technology, "rolls up" air to compress it. The new device operates much like a universal joint, on a principle demonstrated by the illustrated model. During rotation the spaces between a flat plate and the flat faces of two steel blocks vary, thus drawing in and displacing fluid or air. By changing the angles of the shafts, the machine delivers varying volumes of air though it is all the while kept running at a constant speed.

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· Electric Eye

By Robert E. Martin

IN AN Eastern factory, the other day, a score of men crowded around a giant press. The machine towered twenty-five feet in the air. It weighed as much as four locomotives and its massive jaws crunched steel plates as though they were made of paper.

As the group watched, the operator moved his hand a few inches. It crossed the deadline into the danger zone of the crushing jaws. Instantly, as though a spell had been cast upon it, the mechanical monster stopped, upper jaw poised in midair. The operator removed his hand. The machine went on.

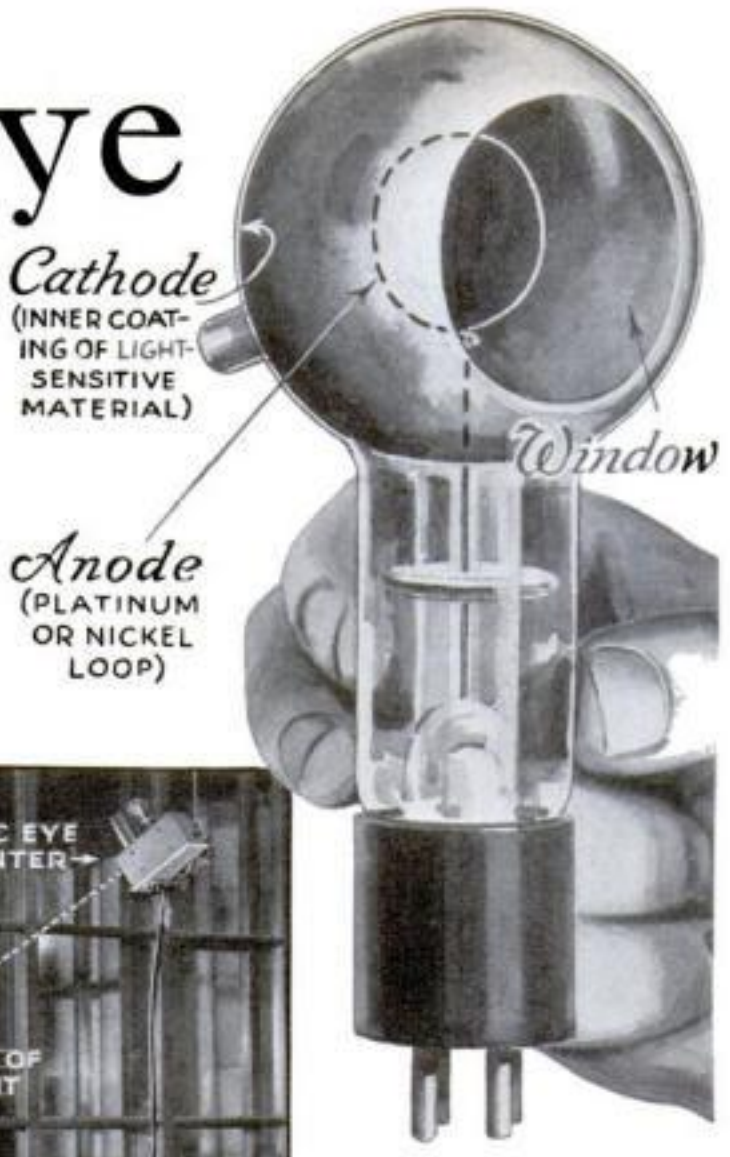
A dozen times, this miracle happened while the group watched. The moment the operator's hands were in danger, the machine stopped and couldn't be started again until they were removed. An unseen eye, an eye made of glass coated with a rare earth metal, was guarding the workman. Focused upon this photo-electric cell, a beam of light marked the danger line. When a hand crossed this line, it intercepted the beam, cutting off the light that reached the cell and stopping, with the speed of electricity, the operation of the machine.

This is but one of a thousand amazing, magical tasks now performed by these "tubes that think." Ranging from the size of a peanut to the size of a pumpkin, the modern photo-electric cell—the electric eye—has found a host of uses. It is sorting beans and buttons, turning on lights and opening doors, calling the fire department and timing races, stopping elevators and measuring stars a thousand times too faint to see.

It was an accidental discovery, made some forty years ago, which led to this modern magic. Heinrich Hertz, the German physicist who first reported the existence of radio waves, noticed that more electricity flowed through an arc lamp when it was exposed to ultra-violet light coming from another lamp. In searching for an explanation, Dr. W. Hallwachs, another German experimenter, hit upon the idea that one of the rods of the fast-burning arc emitted particles of electricity when struck by the light. This laid the foundation for the photo-electric cell, which, in the past decade, has become the wonder-tool of industry.

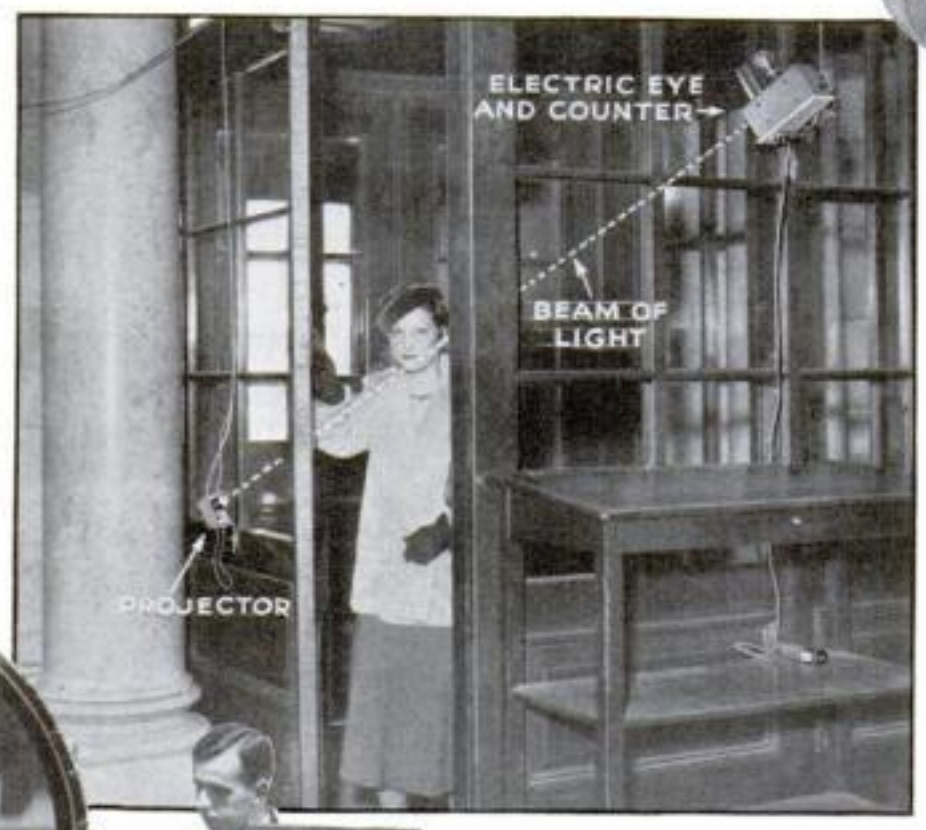
The commonest type looks like a small radio tube and costs from $7.50 to $20. At the center is a platinum or nickel ring. Around it, either in the form of a shield or as a coating on the inside of the glass, is a layer of light-sensitive metal, such as potassium or cæsium. When the tube is hooked to an electric circuit, the central ring forms a positive electrode and the layer a negative one. The space between them acts as an insulator and prevents current passing across, ordinarily. But when the cell is struck by light, the layer shoots off particles of negative electricity. They rush across the gap, forming a bridge of electrons that allows current to flow through the tube.

The size of this bridge, and consequently the amount of current which flows across it, is directly proportional to the amount of light striking the cell. In this way, the electric eye makes and breaks circuits in response to lights and shadows. Relays amplify the feeble currents of the



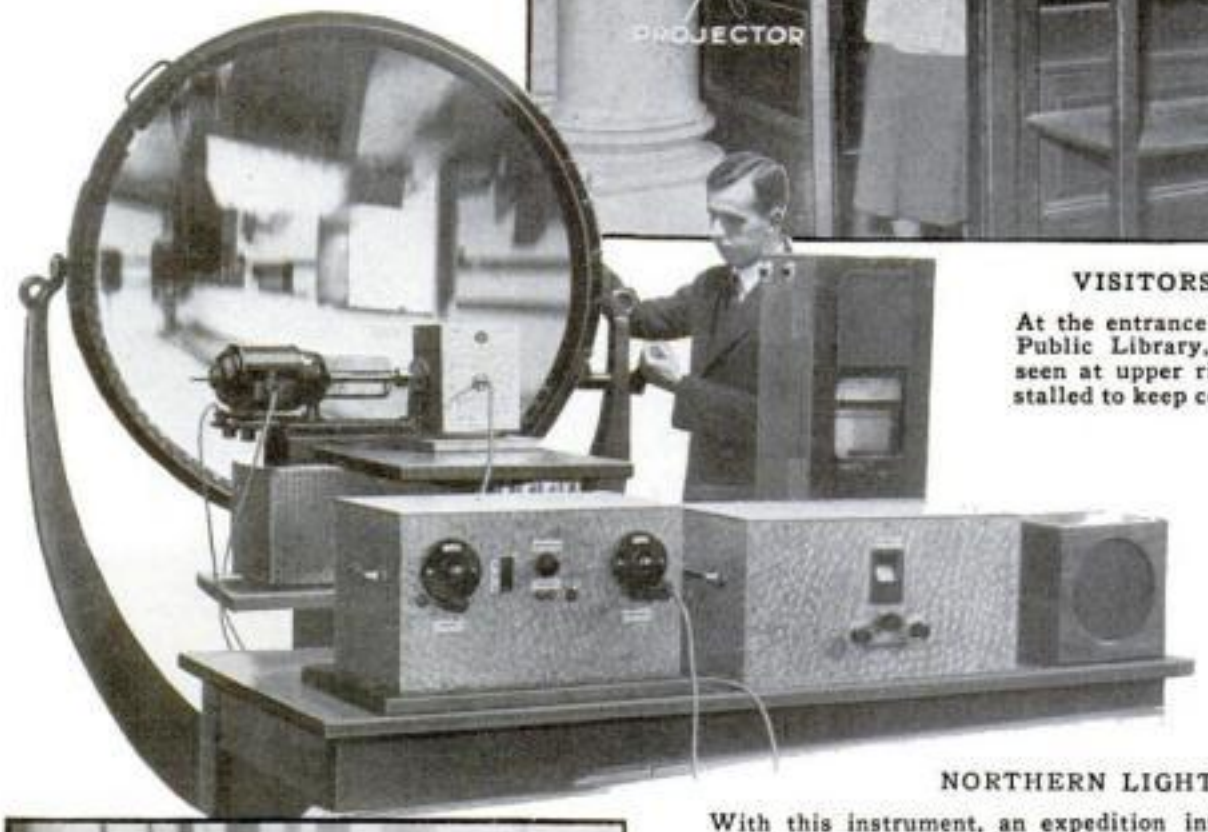
PARTS OF ELECTRIC EYE

Drawing shows the essential features of the photo-electric cell and the manner in which the light actuates its mechanism



VISITORS COUNTED

At the entrance to the New York Public Library, the electric eye, seen at upper right, has been installed to keep count of all visitors



NORTHERN LIGHTS

With this instrument, an expedition into the Arctic will measure the intensity of the Northern Lights. The electric eye and radio will both be used in making analysis

As one bends over this drinking fountain, light from a photo-electric cell is intercepted and this shadow will then instantly turn on the water

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Guides Ghostly Hands

AT A THOUSAND JOBS •

cell a million times to perform some of the heavy tasks for which the tubes are now used by industry.

Thus, in a Pennsylvania coal mine, heavy doors swing open on their hinges at the approach of a dump car and close again behind it, operated by a beam of light. In a western elevator, wheat is weighed by an automatic device in which the arm of the scales intercepts a ray of light at the desired point and shuts off the flow of grain. In an Ohio steel mill, ten-ton ingots rush back and forth through huge rolls, reversed by their shadows.

Not long ago, a large department store in the shadow of the Empire State Building, in New York City, faced an unusual problem. In former days, its chimney rose far above surrounding structures. Now, it was dwarfed by the towering tip of the world's tallest building and, when the wind was right, smoke drifted directly across into the windows of the skyscraper. Protests poured in. The Smoke Abatement Commission sent warnings. Good will, so important to a department store, was endangered.

Officials of the company appealed to a group of electric engineers. They studied the problem and installed a robot smoke watchman. It consisted of a beam of light passing through the chimney and striking a photo-electric cell. When the smoke becomes denser than the law allows, the light reaching the cell is reduced and the automatic watchman rings an alarm bell in the boiler room, flashes on a light in the chief engineer's office, and jots down a record of the exact number of minutes excess smoke pours up the chimney. Guided by such instant warnings, the firemen have been able to regulate their furnaces and complaints have ceased.

In a similar manner, ships at sea are safeguarded against fires. In the hold, beams of light are trained upon photo-electric cells which sound sirens if smoke begins to dim the light that reaches them. Such alarms have also been installed in homes and warehouses to give speedy warning of a starting fire.

A special meter which uses an electric eye to determine the density of smoke has been devised for giving a check upon combustion and the efficiency of a heating plant. Recently, by means of a similar device, the U. S. Public Health Service began recording the *(Continued on page 96)*

Color shades, invisible to the human eye, are distinguished by the photo-electric cell being used at left. Below, photometers which keep careful watch of light bulbs

Electric eyes, one of which is seen at left, below, time the sprinter automatically in thousandths of a second

The electric eye is now used as a safety device. Here it guards the elevator doors which cannot be closed while a person stands in car's entrance

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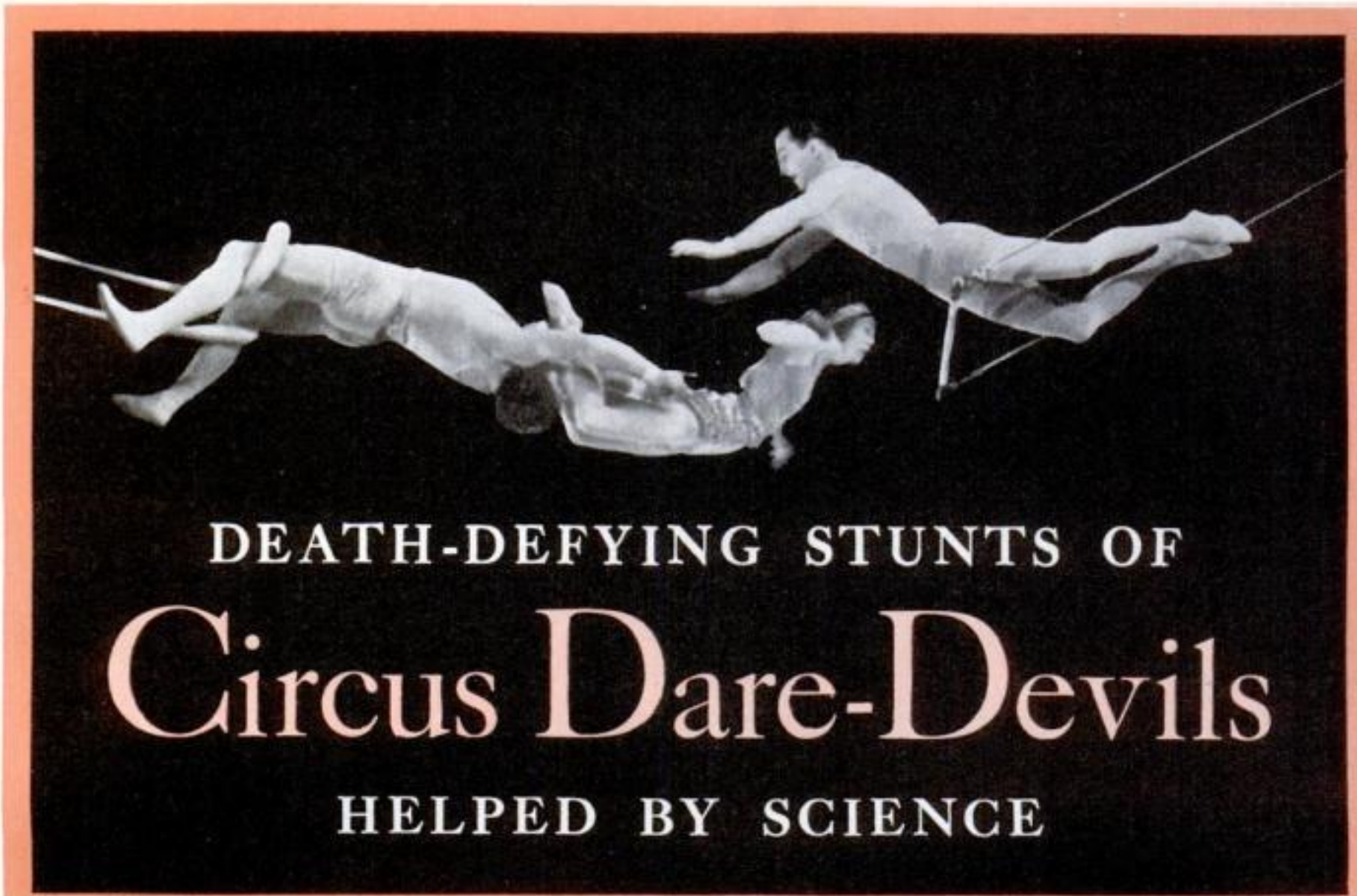

DEATH-DEFYING STUNTS OF Circus Dare-Devils HELPED BY SCIENCE

Lalo, Vera, and Alfredo Codona doing the sensational passing leap which is part of their flying trapeze act

By Fred Bradna

Equestrian Director of Ringling Bros. and Barnum & Bailey Combined Shows

as told to

EARL CHAPIN MAY

WITH 30,000 eyes staring up at them, the Four Wallendas walked a half-inch cable, forty feet above the ground. Merle Evans' busy circus band, entertaining those who had crowded under the big top at Akron, Ohio, stopped playing. Peanut venders suppressed their cries. The large audience breathlessly watched the three white-clad men and a pretty, young girl poise at the center of the long cable preparatory to doing a "three-high" stunt which had made them famous in three continents.

Herman and Joseph Wallenda had their feet on the cable. Each wire walker kept his position with the aid of a steel balancing pole thirty feet long, weighing about fifty pounds. Between the two men stretched a slender rod. Carl Wallenda, also carrying a steel pole, stood upon a chair balanced upon this rod while poised on the cable directly behind her brother Joseph, little Helen prepared to climb over him to the shoulders of Carl. Forty feet below them a group of circus property men held a small safety net designed to catch any Wallenda who might be so unfortunate as to fall.

The cable, stretched across the dome of the tent, ran over a high cross-piece, or "jack," behind the seats and was anchored firmly to the ground outside the tent. Moreover, eight guy ropes kept it from swaying horizontally. The performers were accustomed to their precarious position. They had presented their act in circus tents and theaters for five straight years without suffering a major injury. So far as the human equation could be relied upon, they were just as good insurance risks as the average motorist.

But this night the unforeseen occurred. A truck outside the tent is believed to have backed into the anchored cable. Just as the four youthful German gymnasts, midway of the cable's span, proposed to walk three high to a pedestal and a happy landing, the cable suddenly sagged. Just as suddenly the heavy steel balancing pole left Carl Wallenda's hands and plunged straight down toward the men who held the safety net. Some of them dropped the net and ran!

AT THE same instant, Herman, in falling, caught the cable with one hand and one leg, and gripped Helen with his free arm. Carl, hurtling downward from his falling chair, caught hold of the cable as he fell. Joseph dropped flat against the sagging wire, but hung onto his balancing pole. A few seconds were required to get the safety net in place again. Then, one by one, the four wire walkers dropped into it unharmed. They took their bow; I blew my whistle, and the next act of the big show went on. The Wallendas appeared on the program at the next performance the same as usual.

During a lifetime in the circus, first as a bar performer and later as equestrian director, or ring-master, the number of serious accidents I have witnessed have been surprisingly few. For the wire walkers and shooting stars of the big top take extraordinary precautions against the hazards of their acts.

They plan, and practice what to do in every possible emergency. They measure the distance between trapeze and bars to the fraction of an inch. They study speed and timing—applied ballistics—as a fine art. The equipment they use

Con Colleano in three poses on his

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Thrilling Acrobatic Stunts on High Wire and Trapeze Call for the Most Accurate Calculations

FOUR WALLENDAS IN THEIR FAMOUS STUNT

Balanced on a half-inch cable, forty feet above the ground, the Four Wallendas do the thrilling pyramid stunt pictured here. Once in the midst of this act, the cable sagged and all four of them fell but their training saved them

is regularly given searching tests that detect the slightest flaws. At the factories where this equipment is manufactured, the latest developments of science are often employed to make it perfect. When an accident does occur, the human equation is usually to blame.

IT WAS to blame for the accident that killed Lillian Leitzel, internationally famous for her work on the Roman rings and a single rope. From a small loop of the latter, she performed her spectacular one-arm "kickovers." The act, in itself, was not dangerous. There was little chance of her letting go. But when she was performing at a theater in Copenhagen, Denmark, a property man failed to tighten the rigging. Part of it gave way and Lillian plunged forty-five feet to the stage. Although she got up and tried to walk to her dressing room, she died of concussion of the brain soon afterwards, a victim of the human equation, which is hard to guard against.

I remember one case where the performer himself made the error in setting up his rigging which caused the accident. For twenty-eight years, Walter Guice had been doing aerial bars with various circuses. One of his pet stunts is to swing from the center bar of his high rigging, throw his body over an end bar, and catch a trapeze bar held by his wife. He seldom misses. He knows it is exactly fourteen feet and two inches from the bar he leaves to the one on the trapeze at which he is jumping.

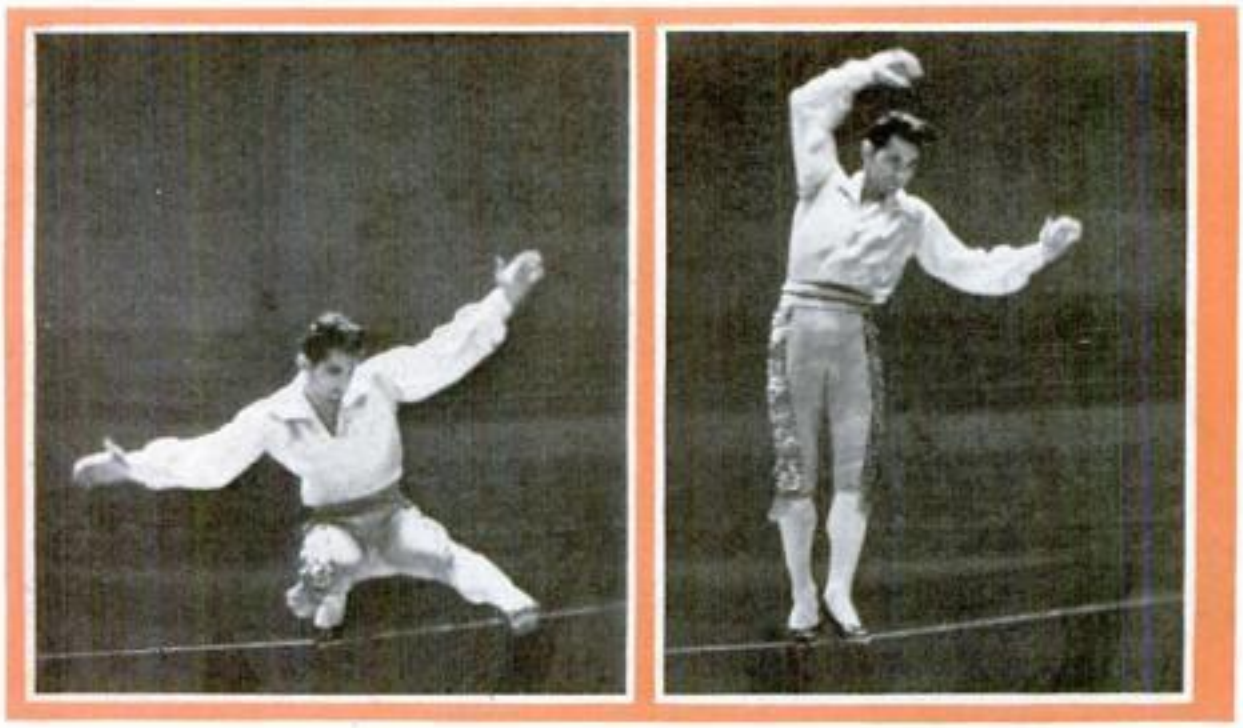
Early in the recent Madison Square Garden engagement, in New York, Guice threw his body toward the trapeze, missed it, tried to pirouette or twist his body so he would strike the apron of the net on his shoulders, got only partly turned and struck on his forehead. Half-paralyzed, he was carried to a specialist who snapped five dislocated vertebrae back in place. He was in the hospital two weeks. When he came out, he did some careful measuring and found that, through his own mistake in hanging the rigging, the bars were several inches too far apart. Those extra inches had caused the accident that sent him to the hospital.

When a gymnast falls, he always tries to "ball up" and land on his shoulders for a rollover. This is the orthodox method of breaking a fall without snapping any bones. Acrobats practice it until in an emergency they do it automatically. A variation of this method of avoiding serious consequences of a slip is illustrated by Harry Rittley's famous performance with a pyramid of tables.

For fifteen years this son of a German circus owner has specialized in falling from the top of six three-foot tables, piled one on top of the other. He starts his fall sitting in an ordinary wooden chair. Midway in his backward descent, he springs away from the chair, lands on his feet, dodges the tables that come tumbling after him, rolls over on his right shoulder, gets to his feet, and takes his bow no worse for his dangerous fall.

THIS is thrilling enough in itself. But, what makes his stunt particularly risky is the long skirt he wears as part of his makeup. The skirt was John Ringling's idea and it gets Rittley an additional laugh because he looks grotesquely like a woman. But there is always the danger that the skirt will become entangled in the chair. Yet only twice has he been injured, although the risks he takes are, theoretically, greater because he weighs almost 190 pounds and is six feet tall. His ankles are always taped and his feet are specially padded and there is a thin pad on the stage where he strikes.

wire. In the first, he is just finishing his dangerous forward somersault



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At the winter camps of the circuses, young children are always eager to practice the feats of trained performers. Here youngsters are being instructed in the early stages of a two-horse riding act

A falling table once broke a rib and his breastbone. The other time, his ankle was broken in turning a back somersault from the fourth table in a chair. This chair somersault has long been one of Rittley's specialties. This time he was working in a muddy ring. His act followed a riding exhibition. In the mud, a horse's hoof had left a deep hole and Rittley's ankle found that hole as he landed and the bone snapped.

HIS regular fall is about twenty feet, vertically, and about the same distance horizontally. In his youth he practiced high diving and today he constantly keeps in training. One of his conditioning stunts is diving backward to a hand-landing from the top of three tables to the top of a fourth, a matter of six feet. To be certain of avoiding injuries to his hands, he must strike the lower table so that his fingers and thumbs, and not his wrist bones, will take the blow. Curiously enough, other gymnasts have done the long fall backward from five tables, each three feet high. But the sixth table, such as Rittley uses, seems to be too much for them. For ten years, Rittley ended his fall with the conventional head roll-over. The jarring began to bother his head, so he substituted the shoulder roll which he now uses.

One of the most dangerous acts in the circus performance is the double-trapeze act you have seen so often. It is usually done by a man and a woman. The routine calls for a foot-to-foot swing. The man hangs by his arms; the woman locks her insteps into the insteps of the man and then, head downward, swings freely forty feet above the ground! There is no net to catch them if they fall. Yet there have been few falls in the history of double-trapeze performances.

The Aerial Smiths, from Bloomington, Ill., did take one fall in which they escaped death by a miracle. The rope sling, holding their trapeze to the dome of the big top, gave way. Mrs. Smith broke her fall by glancing from a tight wire, but her husband fell fifty feet straight down striking on his head. Although he was "knocked out," he broke no bones and was back in the air again in a day or so!

Why wasn't he killed? He cannot tell you. But one of the things that every circus gymnast trains himself to do as part of his preparation for emergencies is to fall limply, like a drunken man. This trick has saved many a star from serious injury.

Most of the daredevils of the circus are inspired by an ambition to do something that no one else has ever done. That is one reason Alfredo Codona, greatest flyer in trapeze history, has been doing a triple somersault from his swinging bar to his brother's hands since his debut with this stunt at the Chicago Coliseum in 1920.

Son of an old-school circus man, Alfredo began studying this stunt in Havana, Cuba, in 1919. Another boy, named Lane, was also trying it. Neither one could quite get it. They could do it occasionally but not consistently. So Alfredo laid off all the next winter and worked at the Shreveport, La., fair ground, day after day, week after week, practicing the triple spin. When spring came and the big top was ready for its swing around the circle, he and his brother, Lalo, had solved the problem and Alfredo has been doing it, ever since. Young Lane attempted it once too often, struck the edge of the safety net, at the Coliseum, and broke his neck.

Because completion of this trick depends upon split-second timing and complete coördination by flyer and catcher, one hundred percent success is well nigh impossible. But Codona does his triple on his first attempt nine times out of ten, which is closely approaching a miracle.

Moreover, he has destroyed a long-established pet tradition that a flyer cannot control his body after a second revolution. For, when he misses Lalo's hands, as he does now and then, he controls his flying body until it strikes the net, landing on his shoulders instead of on the front of his head. Striking face downward on the net is apt to break a vertebra and cause paralysis.

TWO years ago, at Madison Square Garden, we had an instance of that kind. Charley Seigrist, veteran flyer and all-around gymnast, has the custom of finishing his act by turning three somersaults from the top of his rigging into the net. One night at the Garden, he overturned accidentally. His body made three and a half revolutions before it struck. The impact cracked two vertebrae in his neck. On the rebound, the dazed aerialist was bounced out of the net onto the floor. In that final fall of twenty feet, one of his legs was broken against a ring curb.

In spite of these injuries, Seigrist was trying to rise and give the traditional Roman salute when his companions reached him. At the Polyclinic Hospital, doctors trussed his neck up to the ceiling in a light harness. A few nights later a nurse discovered him loosened from the harness and moving his neck experimentally! They put him in a tighter harness. Three months later he walked onto the Ringling-Barnum lot at Glens Falls, N. Y., with his neck all right, and last winter he was doing double somersaults from the trapeze bar to a catcher's hands in one of my indoor circuses. You can't keep a circus squirrel on the ground!

One of the precautions taken by the stars of the big top is keeping in perfect physical condition. They follow systematic, scientific training. What happens when *(Continued on page 86)*

RECKLESS FALL FROM SIX TABLES

For fifteen years Harry Rittley has been entertaining crowds by deliberately falling backward from a chair on top of six three-foot tables. So carefully has he worked out his act that never has he been seriously injured though a back somersault is regularly part of his work

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MISSING!

How Strange Disease Accounts for Army of Lost Persons

By Arthur Grahame

HUNDREDS of men and women right now are wandering through our cities and over our countryside—lost!

Some of them are holding down jobs. Nearly all of them seem to be normal human beings. But they aren't. They are victims of amnesia. They have forgotten where they came from. They have forgotten their pasts. They have forgotten even their names.

They are members of the tragic legion of lost persons!

Now and then an amnesia sufferer is so prominent that his misfortune directs wide public interest to the mental fog that is one of the strangest maladies of the human brain. Such a sufferer was Colonel Raymond Robins, the wealthy social worker who walked out of his New York club one day last September on his way to Washington to keep an appointment with President Hoover, and who was lost until, over two months later, he was discovered, his memory of his past gone, living in the mountains of North Carolina under the name of Reynolds Rogers.

For every victim such as Colonel Robins, whose dramatic disappearance became front-page news, there are hundreds whose tragic plight interests only their relatives and friends.

Such an ordinary citizen amnesia victim was Harry Havery, an insurance man of White Plains, New York.

One May morning Havery went fishing in nearby Long Island Sound. He wasn't having much luck, and an old lobsterman advised him to "go round t'other side of the cove." Havery went. That was the last that the lobsterman saw of him. A little later he saw Havery's empty boat. He found Havery's fishing coat tangled up with hooks and lines and the anchor rope. It looked as if Havery had struggled out of it while in the water.

The police dragged the cove but couldn't find the body. Mrs. Havery got a job to support herself and her four children.

Seven months later a man had to jump fast to get out of the way of a motor truck in the Loop district of Chicago. His foot slipped and he fell, striking his head on the curb. When he got up, his mind was a blank. A search through his pockets disclosed a key with a hotel tag on it. A bellboy helped him to get to bed. Then he lost consciousness.

When he came to, he saw a hotel placard on the wall that showed him he was in Chicago. Slowly memory of the past came back to him. He remembered going out in his boat, talking to the old lobsterman, starting to throw overboard the stone that he used as an anchor, and slipping. Then there was a blank until he woke up in that hotel bed in Chicago.

Havery examined his clothes. He couldn't remember where he had got the suit he was wearing. He consulted the hotel register. The name he had given was strange to him.

He went home to White Plains. His wife gave up her job. Life is going happily for them again. But there is an uncomfortable seven-month blank in his

Vanished Insurance Man is Reported Drowned In Long Island Sound

Lobsterman, last to see Havery, advised him to try his luck on cove's far side

Havery did so and disappeared. His boat was found and he was thought dead

Police dragged the cove in a search for Havery but could not find his body

Seven months later, a man jumped out of the way of a truck, fell and hit his head

Regaining consciousness in a hotel room, Havery remembered his right name

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When a girl was found who had forgotten her name and where she lived, an officer thought she might be a stenographer and asked her to use the typewriter. The initials she signed recalled her own name

memory that probably never will be filled in.

There isn't always a happy ending to the story of an amnesia victim's return of memory.

There was C. H. Peachey, a British soldier who was wounded in 1917. Army surgeons operated upon the wound in his head and discharged him from the service. He shipped aboard a steamer bound for America. After reaching here, he disappeared.

PEACHEY'S mind had become a blank. For ten years, he was a patient in various mental hospitals. Then an operation restored his memory, and he started home.

When he arrived in England he found his wife had married again and was the mother of four children. So Peachey went back to wandering. The one bright spot was that his deaf and dumb brother was so surprised at his reappearance that he regained his hearing and power of speech!

Sometimes memory can be brought back to an amnesia sufferer by suggestion.

A policeman found a young woman in a store doorway in Freeport, Long Island. She didn't know her name, or how she got there. He took her to the police station. The chief guessed from her appearance that she might be a stenographer, and asked her to sit down at his office typewriter. "Just go ahead and type as you would in a business office," he suggested, hoping that his guess would prove helpful.

A few minutes later she handed him a neatly typed letter. It was an order for dyestuffs. At its bottom was the stenographer's reference sign: "M. L. C.—M. M."

"Who's 'M. L. C.'?" asked the chief.

"Why, Mr. Cohen," she replied.

"Oh," said the chief. And, casually: "And who's 'M. M.'?"

"'M. M.'? Marion Mitchell. Why, that's my name!"

Then she remembered her address. They sent her safely home to her mother in New York.

Just what is this strange malady that robs men and women of all remembrance of their past lives?

Could you examine the brain of a living amnesia sufferer, you would find it in no way different from the brain of a person whose memory is normal. Amnesia is a functional disorder of the brain, and, like other functional diseases, cannot be traced to any organic lesion or to any change of structure in the organ affected. Amnesia seldom is caused by a physical injury, although quite often it is the result of the shock of a physical injury. Psychologists call it a condition of dissociated personality. Often its cause is emotional shock, for emotions of overpowering strength, such as terror and horror, tend to disrupt the mind.

There are several distinct forms of amnesia. The victim of epochal amnesia suddenly loses all memory of past periods of his life—periods that range in length from a few days to many years. That's what happened to Alvin Carlson, who was picked up wandering in Chicago after being demobilized in 1919. After he had been sent to a veteran's hospital, over a thousand high schools were communicated with in an unsuccessful attempt to identify him through a class ring he was wearing. In 1929 a Red Cross paper published the story of this living unknown soldier and his picture. Out in Montana, the picture was recognized by his brother, who went to see him. Memory came back to Alvin as suddenly as it had departed. "By gum," he exclaimed, "it's Ed!"

Another victim of epochal amnesia, a Russian who had lived in America for many years, forgot everything since his early childhood—forgot, even, how to speak English.

EVEN more embarrassing was the predicament of a young woman who forgot her entire past, and after six months regained her memory and forgot everything that had happened during her period of amnesia. She found that she had become engaged to a man who now was a perfect stranger to her! Nearly always, after an abnormal period passes, memory of that period is lost, or becomes hazy.

In episodic amnesia, the sufferer loses all memory of some particular episode, often one that has been extremely important in his life; but except for that one blind spot, his memory remains normal. A young woman who had an unpleasant experience with a man named August forgot everything in connection with the experience—forgot so thoroughly that in listing the months of the year she skipped the one between July and September!

IN CONTINUOUS or anterograde amnesia the victim forgets every experience as soon as it is over.

Amnesia often is produced by external suggestion. People forget things because they want to forget them. A young woman who had been wrestling with some knotty problem until she was mentally exhausted said to herself after going to bed: "I shall go to sleep and forget everything, even my name!" The next day, as she was about to give her name over the telephone, she found that she had forgotten it exactly as she had planned.

I recently asked Dr. W. L. Treadway, Assistant Surgeon General of the United States Public Health Service in charge of the Division of Mental Hygiene, what are the more common causes of amnesia.

"In many cases," Dr. Treadway told me, "amnesia is a subconscious way of escape, a flying from unpleasant reality. Soldiers who forget their unpleasant or terrible experiences in battle sometimes have a normal memory of everything else. Men who are confined in prison often develop amnesia, because subconsciously they refuse to face the bitter reality of disgrace and punishment. Amnesia is their way out.

"For the same reason, soldiers who have gone through horrifying ordeals in war sometimes develop functional blindness or deafness or paralysis. There is nothing wrong with their sight or hearing or muscles, but they are so anxious not be sent back to the front that they honestly think that there is, and until they are cured, usually by suggestion, they can't see or hear or move, as the case may be.

"Contrary to general belief, few cases of amnesia are (Continued on page 92)

Horrors of War Caused Many Cases of Amnesia in Army

Soldiers who have gone through horrifying ordeals in war sometimes believe they are blind, deaf, or paralyzed. Actually there is nothing wrong with them, but until they are cured their imagined affliction remains. Thus it is evident that amnesia is a subconscious way of escape from unpleasant realities. Men in prison often develop amnesia because they refuse to face the bitter fact of disgrace and punishment. Few cases of amnesia are the result of overwork, though dislike of work may cause it.

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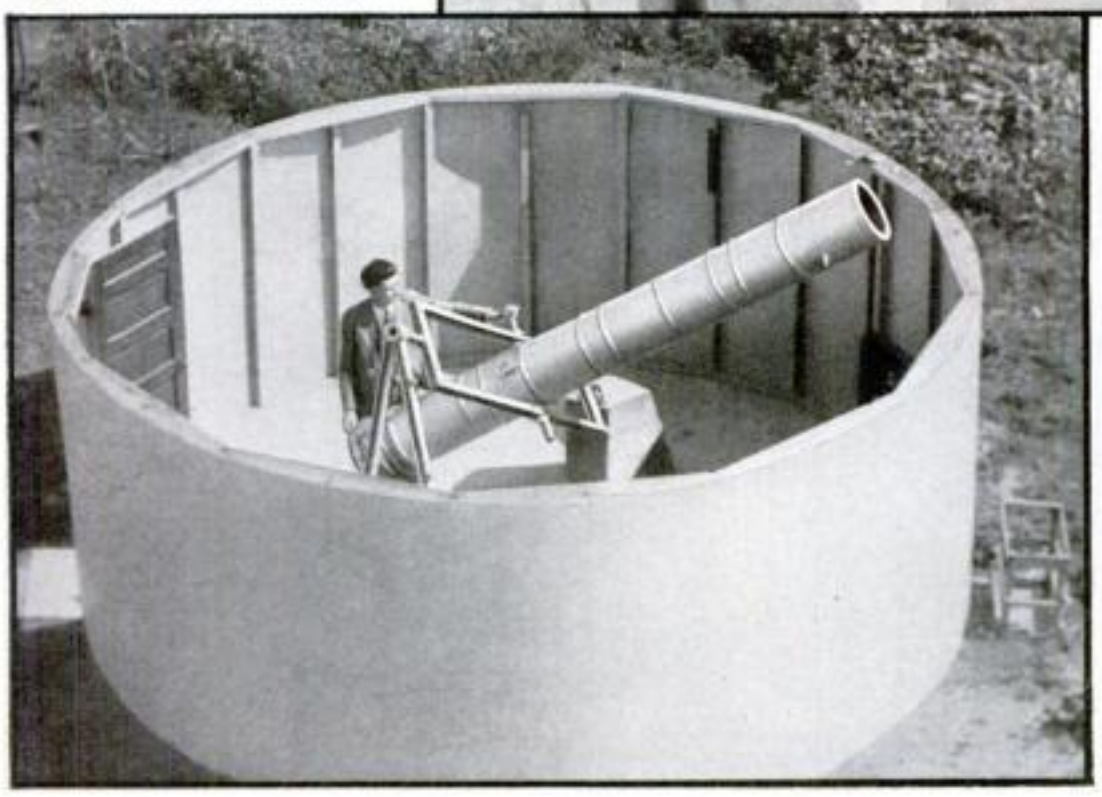
Observatory Built of Junk

Great Earthquake Registered on Homemade Instrument—Horsehairs Make Hygrometer

WHEN slippage along an old fault sent violent earth tremors through southern California recently, it wrote a detailed story upon homemade instruments in an amateur scientist's laboratory near the center of the disturbance. Upon the black drum of a home-constructed seismograph, it swung a needle, giving its builder, Martin G. Murray, a record of the disaster. Ever since last December, Murray had noticed an increase in the number of tremors. Fom December 16 to 26, his instrument registered fourteen shocks. In March came the quake that left hundreds of buildings in ruins. During the forty-two hours of that quake, the needle registered 1,144 shocks. Six distinct types of tremor could be identified. Murray's homemade seismograph was built from an old clockworks, a coffee can, a metal beam, a ten-pound weight, two hacksaw blades, and odds and ends. A spring wire traces a record upon a revolving drum covered with smoked paper. A ten-pound weight, moved by a tremor, actuates a horizontal pendulum that scratches a record upon the revolving drum. The seismograph is only one of a number of instruments built by Murray for his home laboratory. A sundial, with plumb bob and correction curve, gives him exact astronomical time. A hygrometer, contrived from four horsehairs, whose stretching actuates a pointer upon a protractor scale, measures the moisture in the air. The largest instrument is a twelve-foot telescope, with handground mirror.

Four horsehairs and old clock parts were used to make the hygrometer shown at right, with which moisture in the air is measured. Below is a view of Murray's observatory, which, like the instruments was built from odds and ends

Here is the homemade telescope. The tube is an old redwood water main. It is mounted in the frame of a junked automobile. The mirror was ground by hand



On this seismograph, the recent severe quake in California was recorded. It is made of old clockworks, a coffee can, a metal beam, a ten-pound weight, and two hacksaw blades. It registered 1,144 shocks in forty-two hours

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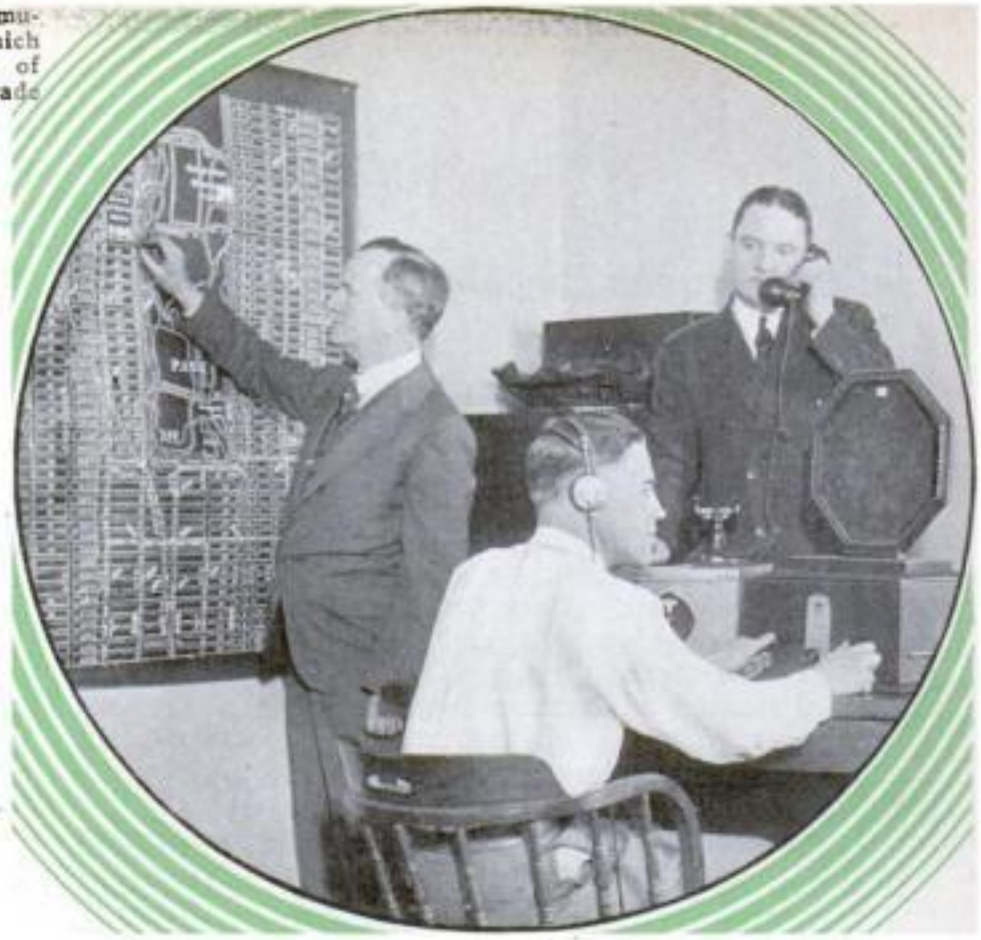
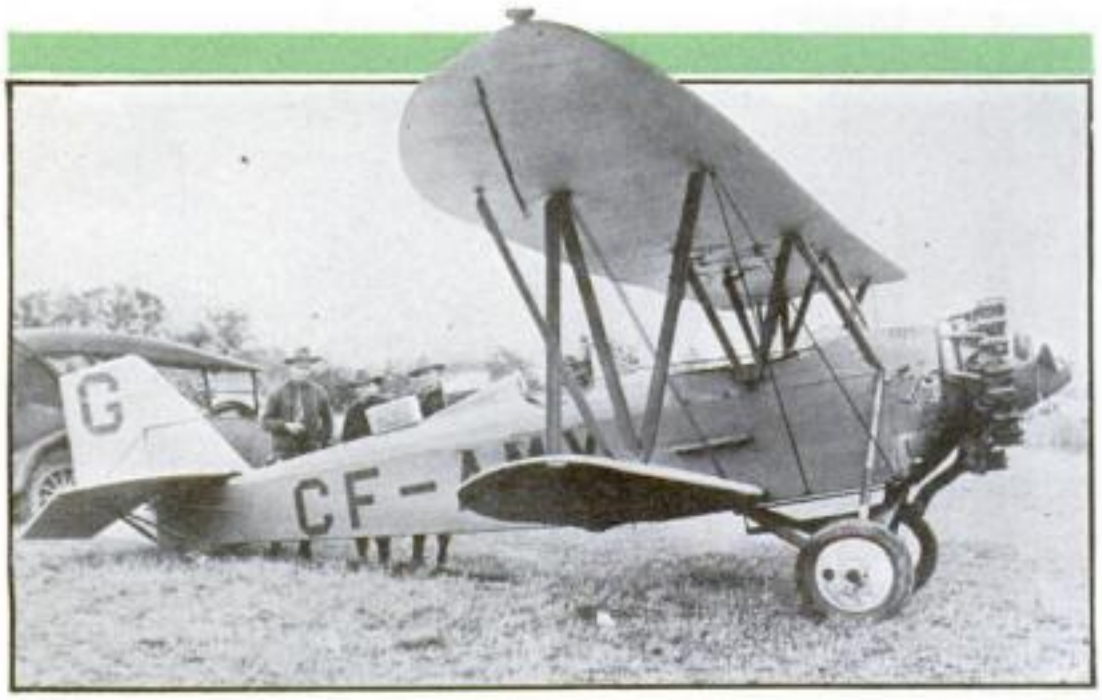
Police officials in radio communication with aircraft which were assisting in direction of traffic during a recent big parade

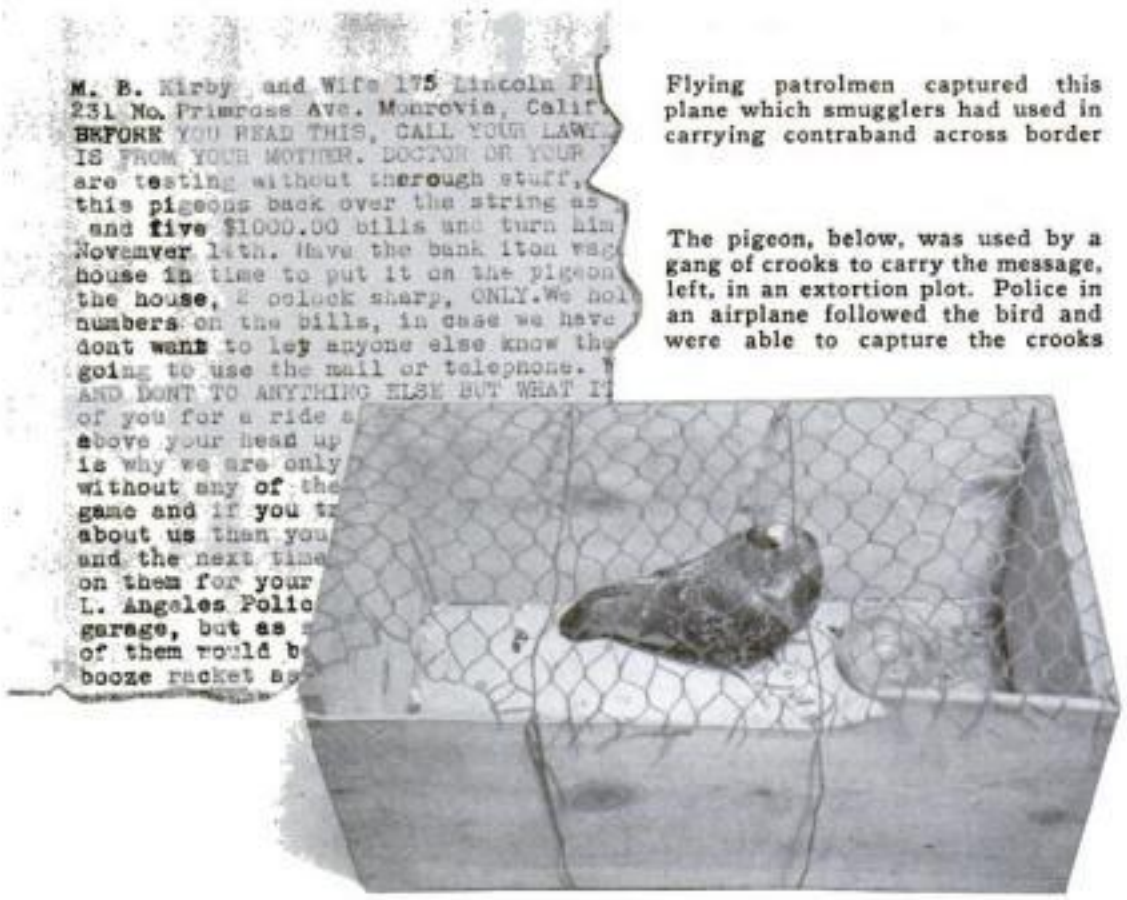


Flying Police

OUTWIT CROOKS of the AIR



Flying patrolmen captured this plane which smugglers had used in carrying contraband across border



The pigeon, below, was used by a gang of crooks to carry the message, left, in an extortion plot. Police in an airplane followed the bird and were able to capture the crooks

URLED into the pounding surf, a thousand yards from shore, seven members of the crew of the navy blimp, J-3, were fighting for their lives.

It was the morning after the loss of the U. S. Navy dirigible *Akron*. This second tragedy had occurred as the blimp returned to Beach Haven, N. J., after an unsuccessful search for survivors. A forty-five-mile an hour gale had caught the lighter-than-air craft, driven it out to sea, and sent it crashing into the water with ripped bag and disabled engine.

Spectators crowded the shore. They knew the men would be smothered by the gale-lashed waters long before a boat could reach them. Suddenly, overhead there was the high whine of an aerial motor. A silver-winged amphibian was scudding under the low, black clouds, heading for the wreck. It swooped, landed like a seagull on the tossing ridges of water, and the two occupants began dragging the floundering men to safety within the craft's cockpit.

One, two, three, members of the crew were hauled onto the slippery hull of the amphibian. Spray was drenching the motor. Three of its five cylinders went dead. A fourth swimmer was pulled on board, then a fifth. The two others had disappeared beneath the waves, a fate which would have overtaken all seven but for the quick action of the flying lifeboat. As it worked its way to shore and slid up on the beach, the cheering spectators saw painted on the side of its drenched hull the word: POLICE.

In this dramatic fashion, a few weeks ago, Pilots Otto Kafka and John W. Forsythe, of the New York City Police Aviation Service, focused attention upon the work of the flying patrolmen. In a dozen American cities, the police have added wings to their crime-fighting equipment. Aerial cops are patrolling regular beats, trailing kidnapers, fighting gangsters of the sky. All over the country, flying law officers recently have been active in their pursuit of criminals.

A few days ago, they swung into action near Laredo, Texas, in a thrilling, 150-mile race which ended in the capture of an outlaw plane. Two crack members of the U. S. Border Patrol were

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Two types of aircraft now in use by the flying officers. At the left is a seaplane with which water routes are patrolled. At right, fast regulation plane

Thomas M. Johnson

tells how trail of crime now leads above the clouds as the skyways are patrolled in fast planes that drive gangsters and smugglers down to earth

•

cruising at 5,000 feet over the Mexican line when they saw a plane below them streak across the Rio Grande and head north with engine wide open.

They dove their ship and signaled the plane to land. The only answer was an added burst of speed. For more than a hundred miles, the two planes battled nip and tuck before the patrol ship nosed abreast. This time the law officers signaled the fugitive to land with the muzzle of a machine gun. He landed. A search of his ship revealed that it was laden with narcotics. The pilot was a World War ace who had fallen upon evil days and had succumbed to the lure of easy money offered by a dope-running syndicate.

Equally spectacular are a score of other encounters aloft.

Take the experience of the air police at Long Beach, Calif., not long ago. High over the surf, one of their planes battled a speedy gangland craft which attempted to force it down with machine-gun fire! The fast monoplane of the outlaws had made a daring landing at Vail Field with two Chinese it had flown across the border from Mexico. Dropping the aliens at the far end of the field, it had roared into the air again before anyone could stop it.

A police plane took up the chase. In a flash, the flying gunmen turned and bore down on their pursuer with bullets streaking from a machine gun. Diving and twisting the two planes engaged in a dogfight rivaling the air battles of the Western Front. Finally, the monoplane dived into a bank of pea-soup fog, rolling in from the sea, and disappeared.

Near Monrovia, Calif., law officers took to the air in a chase of an entirely different kind. This time, they were trailing, not a plane, but a fleet-winged carrier pigeon.

Extortionists had demanded $10,000 from a wealthy citizen. He was instructed to release a pigeon, which had been sent him, with ten one-thousand-dollar bills tied to its back. He notified the police, who released the bird and followed it with two fast planes. They traced it to the loft of a well-known pigeon fancier. He reported that he had sold the bird, a short time previously, to two strangers whom he later identified at the rogues' gallery as ex-convicts. A police alarm was broadcast for the men. They were arrested in a shack on the edge of town, still waiting for the pigeon to bring them the money. They had miscalculated the time necessary for the bird to become accustomed to its new home. Instead of coming to the shack, it had returned to the loft where it had been bred.

In a similar manner, another extortionist was trapped in New York City. In this instance, to aid the flying cops, the pigeon was painted bright orange!

The bird had been sent to a Brooklyn judge with a note demanding $2,500 for the return of his missing son. The jurist showed the pigeon to Air Patrolman Otto Kafka and a fellow pilot.

"Can you follow it?" he asked.

They examined the bird. It was gray-blue in color. The pilots saw it would be almost impossible to keep it in sight against the gray background of city buildings.

"We can, if we can paint it orange," they told him.

It was done. Then the bird was released from a high building over which the two police pilots were cruising. Twice the painted pigeon circled in the air and then it headed due east with the flying cops close behind.

At Jamaica, *(Continued on page 94)*

This photo shows the police plane rescuing survivors of the wrecked Navy Blimp J-3 which crashed into the sea while in search of members of the crew lost when the *Akron* foundered

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•New Facts Discovered About *Butterflies*

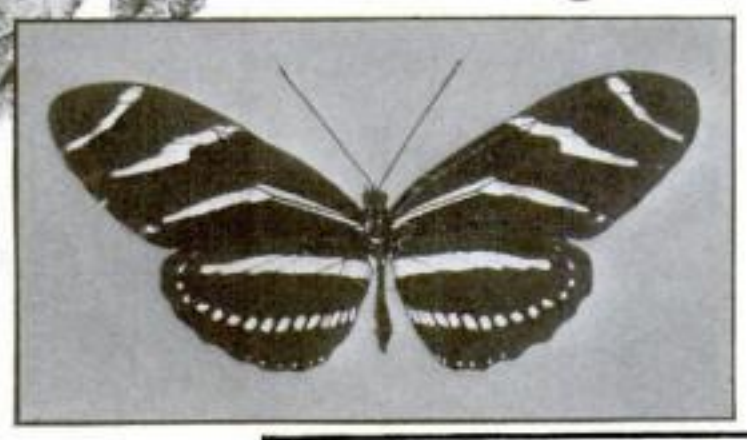
COLORING A BUTTERFLY

Dr. Karl Huttrer, Viennese scientist, demonstrates the manner in which he colors live butterflies. He is injecting a colorless chemical into the chrysalis of an orange-and-black insect. Hatched, it will be black

SOUND ASLEEP WITH HEADS ALL HANGING DOWN

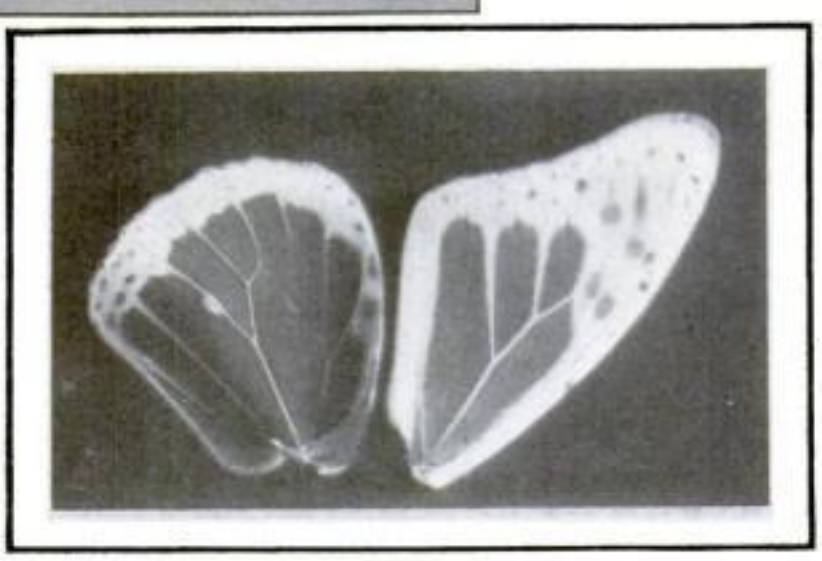
Like hens on a roost, Zebra butterflies of Florida gather nightly on a communal branch to sleep, hanging there with heads down. Frank Morton Jones discovered that one of them may return for several nights to the same branch. At left, a close-up of a mounted Zebra Butterfly

Courtesy American Museum of Natural History



MYSTERY RAYS FROM THE WINGS

Photographic plates are affected by the rays that come from the wings of a butterfly. This picture was made by placing wings of a Monarch butterfly in contact with a plate and keeping it there in total darkness for thirty days. Rays may be gaseous emanations



SURROUNDED by test tubes and flasks, a young Austrian scientist sits in his Viennese laboratory, engrossed in a task as strange as that of any alchemist of old. He is trying to create an artificial butterfly. Dropping chemicals on prepared models of paper and gelatin, he watches them spread into many-hued lines and rings, in the hope that he will be able to duplicate the pattern of real insects. Then he will know the answer to the riddle that has baffled experimenters: How does nature paint butterflies with designs of such exquisite intricacy, in tints that no chemist has hitherto been able to match?

Mysterious, invisible rays have been found to stream from the wings of butterflies. The rays can fog a photographic plate, kept in total darkness. Interested by this strange phenomenon, Austin H. Clark, of the U. S. National Museum, recently attempted to find its cause. He examined forty-three different kinds of butterflies, some fresh specimens, some fifty years old, and found that every one of them emitted the rays. But their origin remains almost as mysterious as before. One thing alone was definitely proved: since the rays are stopped by glass or quartz, they cannot be akin to light or X-rays, and may therefore be some sort of gaseous emanation.

Certain species of butterflies have their own curious traits, and the strange sleeping habits of the yellow-and-black Zebra butterfly of Florida came in for scientific investigation not long ago. Most butterflies spend the night sleeping alone, among grass roots or in bramble thickets, but as many as sixty Zebra buttterflies will congregate nightly upon a single bush like hens in a roost. At daybreak they fly away; apparently the same individuals return to the roost at night.

To verify this, Frank Morton Jones, noted naturalist, adopted a plan resembling the banding of birds to trace their movements. He clipped identifying nicks in the wings of several Zebra butterflies, and waited eagerly the following night for the return to the sleeping bush of the marked individuals. Every one returned. Moreover, observations on successive nights showed that a given individual repeatedly chose the same twig for its resting place.

Other strange facts about butterflies, not hitherto suspected, have lately come to light. One experimenter finds that butterflies of each species have a characteristic odor, ranging from heliotrope and mignonette to that of sweet biscuits. Another is investigating the possibility that males and females are attracted to each other by the ultra-violet coloration of their wings, invisible to human eyes but not to those of insects.

It remained, however, for Dr. Huttrer, the Vienna experimenter, to attempt the bold

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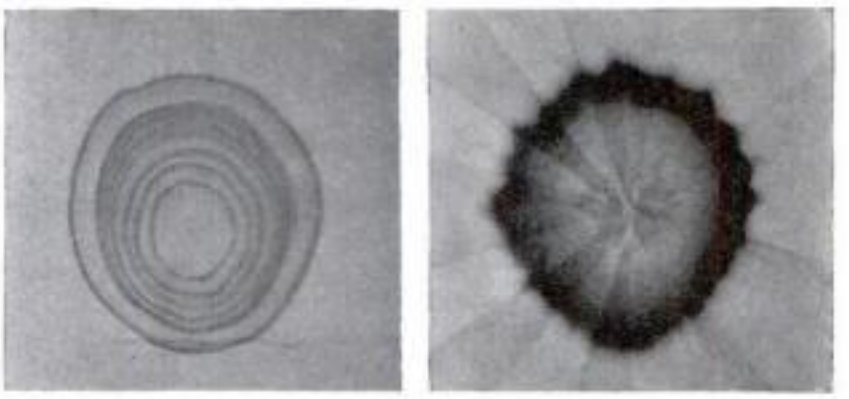
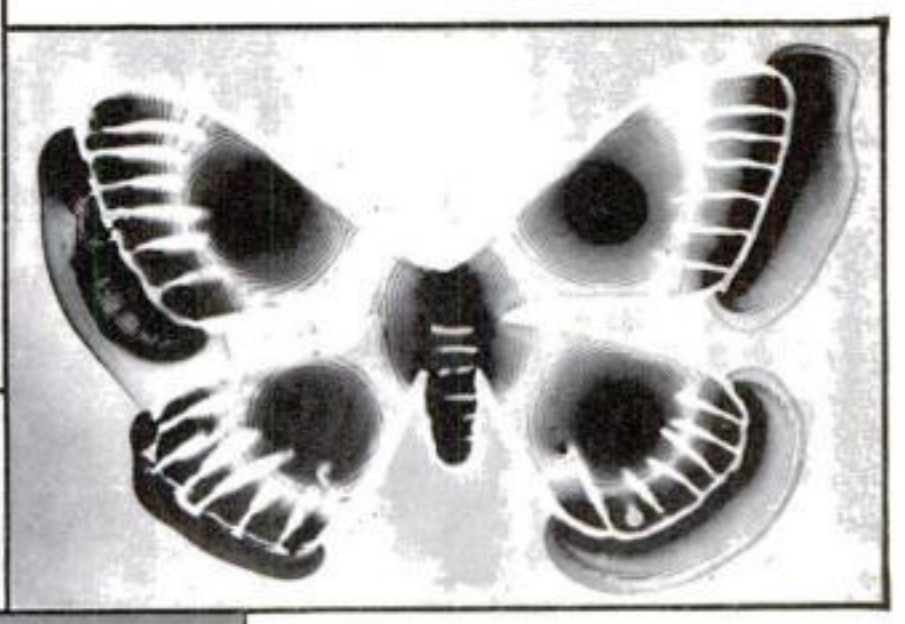
Synthetic Insects Created in Attempt to Explain Mysterious Coloring and Radiation

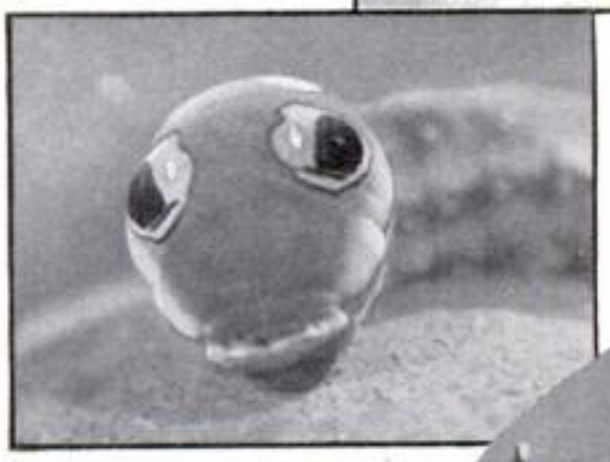
Monarch butterfly, noted for its long-range flights which carry it many miles out to sea



ARTIFICIAL EYESPOTS. Here are two characteristic eyespots that were formed in the laboratory by Dr. Huttrer. Scalloped edges of one at right were obtained by creasing the paper before chemicals were applied, as described in text



A LABORATORY BUTTERFLY. This looks like a real insect but it was produced by impregnating gelatin with pigment-forming chemicals. The lines, however, strongly suggest the pattern found on the live butterfly. This was one of the laboratory experiments

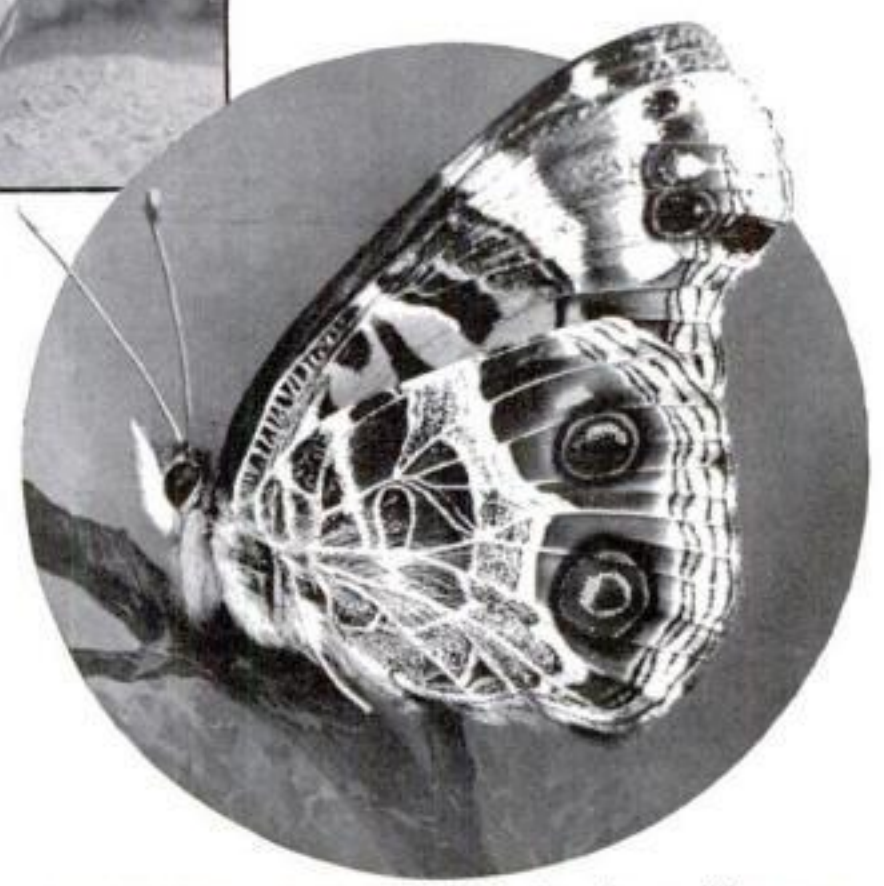


Head-on view of the caterpillar of the Spice-Bush Swallowtail butterfly. The eyes cannot see but doubtless are designed to frighten enemies

feat of coloring live butterflies to order, as his first step in seeking to learn how they get their hues. As every nature student knows, a butterfly in its life cycle passes through four successive stages—the egg, the caterpillar, the dormant pupa or chrysalis, and the adult insect. Since a butterfly acquires its wings and coloring during the pupa stage, Dr. Huttrer began his tests with chrysalids.

The black pigment of a butterfly's wing, like that of human hair, is melanin—a compound formed in nature when tyrosine, a colorless chemical, is acted upon by a certain enzyme. It occurred to the experimenter to see what would happen to a developing butterfly with an overdose of tyrosine. He injected the fluid with a hypodermic needle into chrysalids of the European Tortoise-Shell butterfly, whose wings normally have an orange-and-black pattern. When the chrysalids hatched, the butterflies that emerged were all black—a phenomenon as surprising as if he had turned red-skinned American Indians into negroes.

Having succeeded in this feat, Dr. Huttrer was ready to try to create an artificial butterfly. He prepared surfaces of paper and gelatin in the shape of butterflies, and impregnated the models with pigment-forming chemicals. Synthetic butterflies with startlingly lifelike patterns resulted. Even the curious eyespots of some butterflies were duplicated artificially by the same method. In one test, Dr. Huttrer creased the paper before applying the chemicals, and obtained an eyespot with scalloped edges. This pattern occurs in several butterflies, and the novel experiment indicates it is probably due to the manner in which the insect's wings are folded inside the chrysalis at the time they become colored. Tests like these, which Dr. Huttrer is continuing, are solving long-standing biological riddles; while, from the amateur naturalist's viewpoint, they lend added fascination to the observation and study of the 650 known species of butterflies that are found in the United States and Canada, brightening the summer landscape with their rainbow hues.



NATURE'S STRANGE EYESPOTS. Here is a striking example of the mysterious eyespots that appear on many species of butterflies. Note also, the intricate and beautiful pattern on wing

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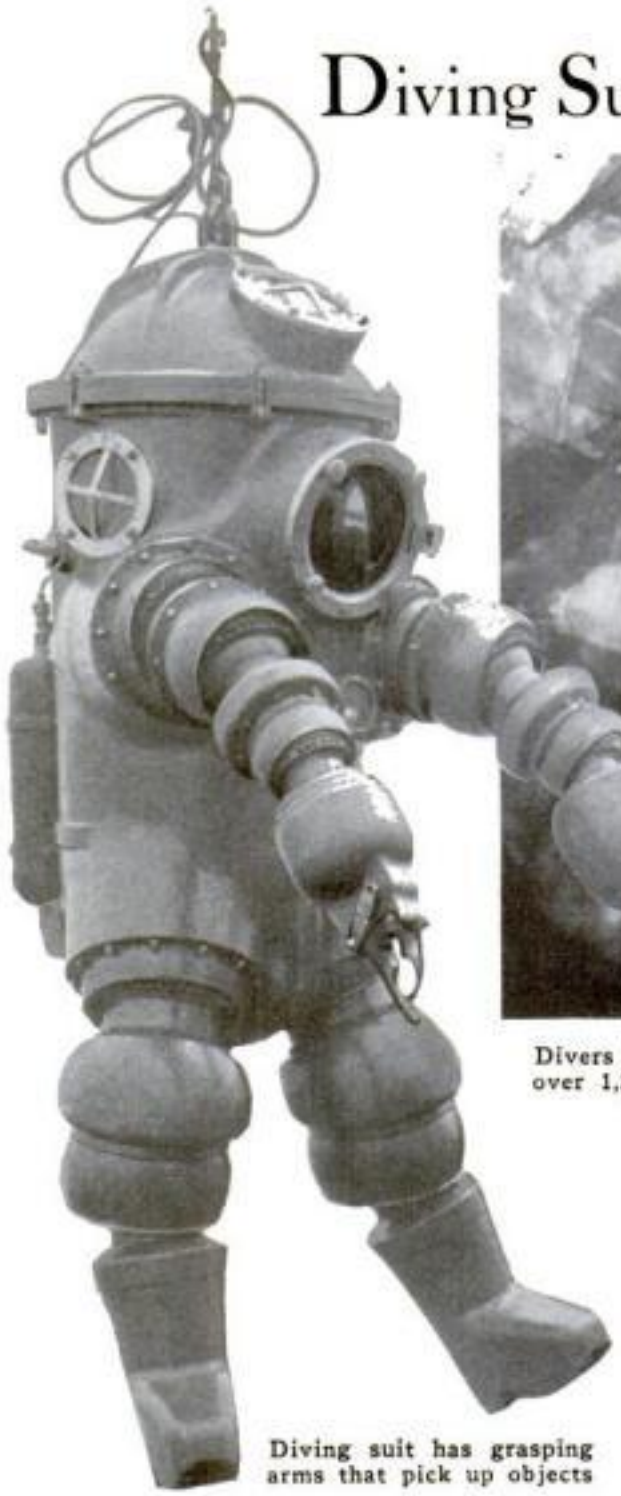
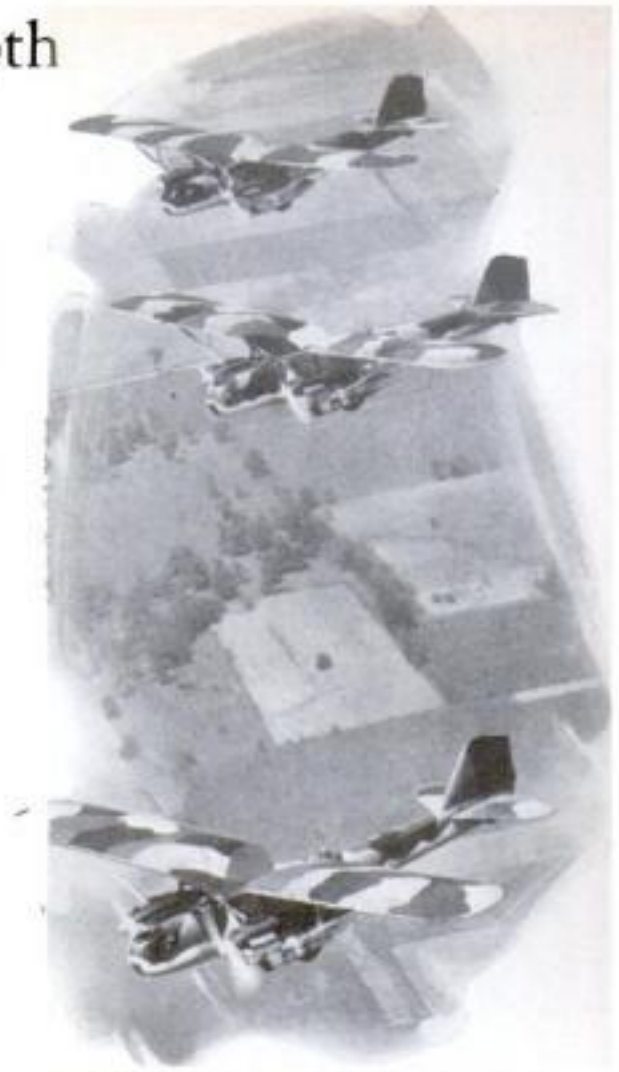
Diving Suit for 1,300-Foot Depth



Diving suit has grasping arms that pick up objects

Divers are expected to be able to work at a depth of over 1,300 feet in this diving suit with oxygen tank

DIVING to a depth of a quarter of a mile below the waves, about three times as deep as present-day armored diving equipment permits, is expected to be made possible by a new deep-sea suit tested in England. Encased in a heavy articulated shell of massive metal, the diver breathes from his own oxygen tank. Hydraulic plungers operate the heavy limbs, and the diver can pick up objects with pincers at the end of each arm.



ARMY AIRPLANES ARE AGAIN CAMOUFLAGED

REMINISCENT of the World War, camouflaged airplanes again made their appearance when a fleet of Army bombers roared over Dayton, Ohio, in recent military maneuvers. The modern machines can speed at 220 miles an hour, and carry five men and 2,000 pounds of bombs—a remarkable advance over war machines.

SHOES SHINE THEMSELVES WHILE WORN

Leather in this shoe is impregnated with materials that always keep it polished

SELF-SHINING shoes are reported to have been perfected as a result of a new laboratory discovery. This is a method of impregnating leather with filling and lubricating materials that are forced to the surface by the heat of the feet. An occasional rubbing is sufficient to keep the shoes shined, and no dressing is necessary. The new leather can be made in all colors, and is said to be scuff-proof and water-resistant as a result of the treatment it receives.

The durability of the leather in self-polishing shoes is tested and is also aged in this laboratory

RADIO SET BUILT INTO ARM CHAIR

BUILT into a new armchair, a radio set provides an arrangement that would satisfy the most comfort-loving person. Entertainment may be turned on or off merely by touching the knob at the front of the chair, which is concealed by a hinged wooden arm when the set is not in use. When the panel, shown open in the picture above, is closed, no one would suspect the presence of the hidden broadcast receiver and its loudspeaker. The latter is visible at the extreme rear in the photograph above that illustrates the set.

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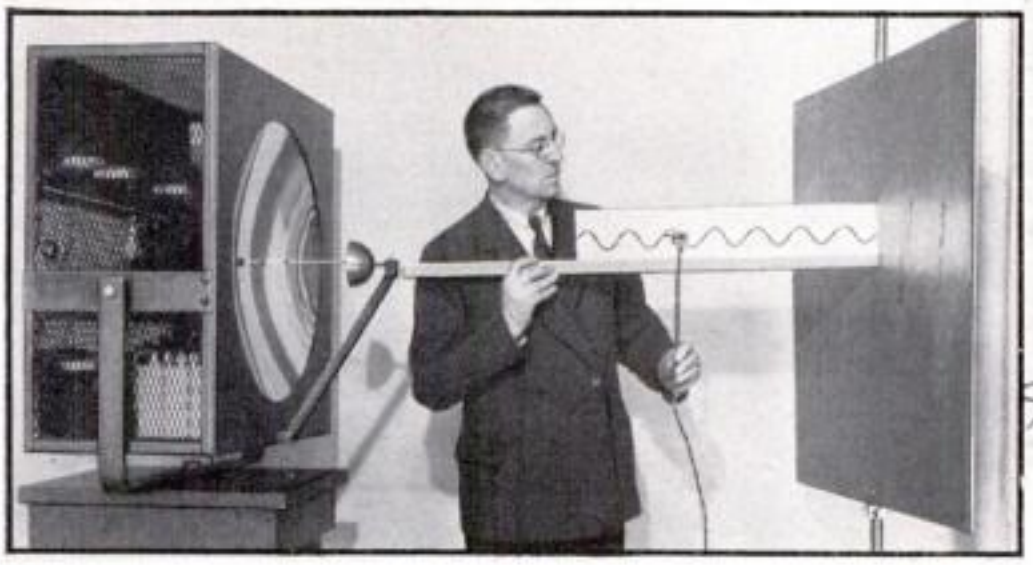
Power Transmitted by Four-Inch Radio Wave

HAILED as a step nearer the transmission of power by radio, and as offering possibilities for television and signaling through fog, a new ultra-short-wave radio transmitting and receiving outfit is said to be the first to make practical the use of waves only nine centimeters, about four inches, in length. A metal reflector, two feet in diameter, focuses the rays so they may be aimed directly at the distant target, which is a mirror that looks exactly like the transmitter, but which has a tiny receiving antenna at its focus. Voices and conversation have thus been carried more than a mile, and future experiments may also enable appreciable quantities of power to be transmitted. The present transmitter radiates about one watt of energy.



Radio transmitter operating on a four-inch wave that radiates power. At left, length of these waves is shown by the wavy line

NEW TOOL SPACES AND PLANTS GARDEN SEEDS

HOME gardeners and truck farmers may do their planting quickly and accurately with the new seeder illustrated above. Opening and tamping down its own furrow, it spaces the seeds with machinelike regularity by means of the notched revolving disk shown in photo at right. This catches a measured quantity from the hopper at each revolution. Six interchangeable disks handle all sizes of vegetable seeds.

A garden seeder's disk that spaces the hills

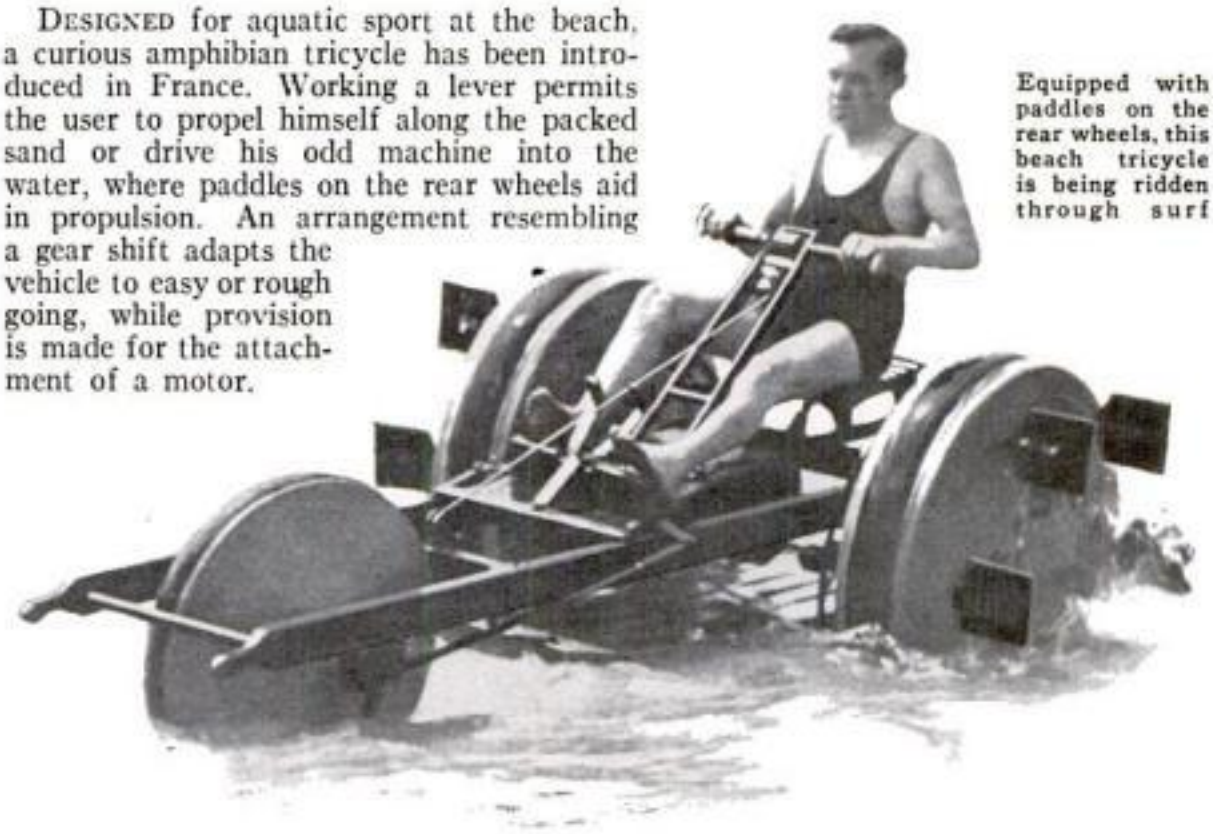
AIR PISTON SPREADS TIRE

TO REDUCE the labor of spreading heavy truck tires, a Brooklyn, N. Y., garageman invented the ingenious tool illustrated at the right. A small piston, operated by compressed air, pulls the casing open in a jiffy when the garage air hose is attached to it. As easily carried about as a jack, the tool makes it unnecessary to tug the unwieldy tire from one part of the garage to another.

Piston, worked by compressed air, easily opens a truck's tire

RIDES BEACH TRICYCLE THROUGH SURF

DESIGNED for aquatic sport at the beach, a curious amphibian tricycle has been introduced in France. Working a lever permits the user to propel himself along the packed sand or drive his odd machine into the water, where paddles on the rear wheels aid in propulsion. An arrangement resembling a gear shift adapts the vehicle to easy or rough going, while provision is made for the attachment of a motor.



Equipped with paddles on the rear wheels, this beach tricycle is being ridden through surf

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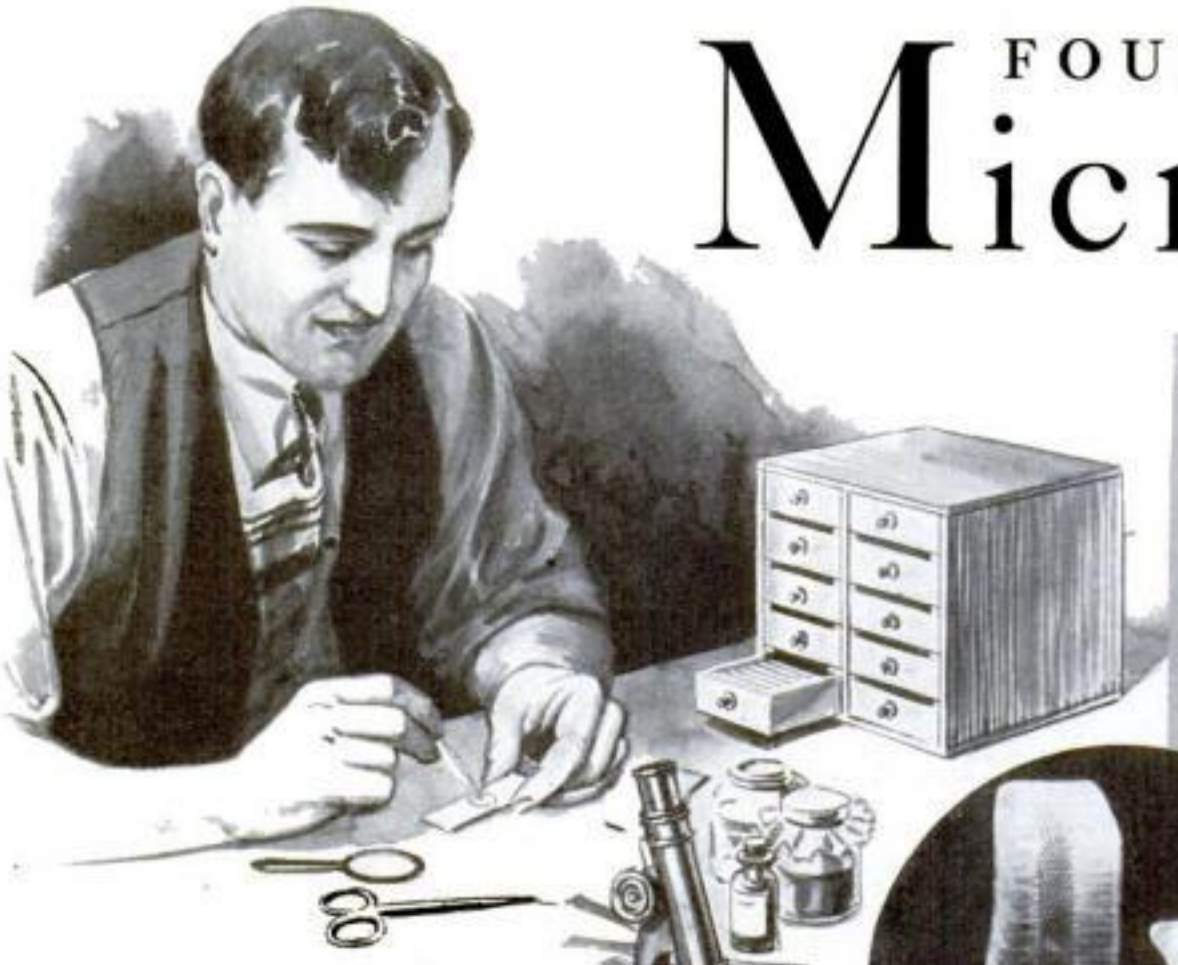
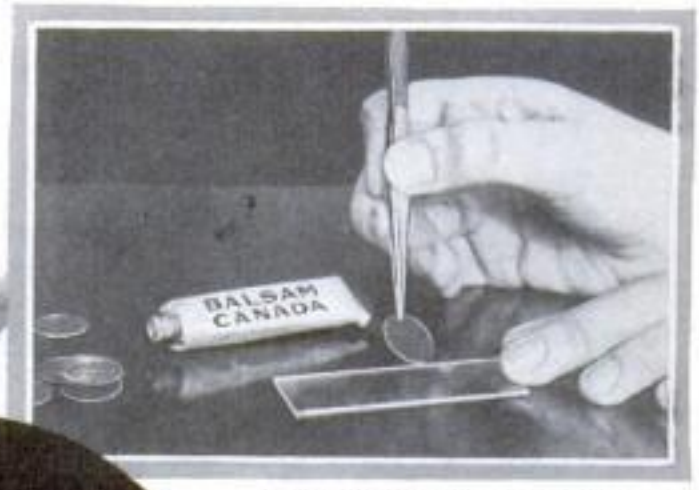
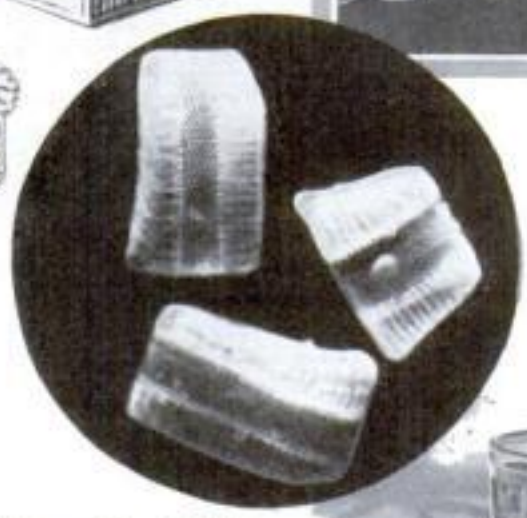
Matchless Flowers FOUND WITH YOUR Microscope



An ordinary medicine dropper or a pipette often is used by the microscopist in transferring small amounts of mud and water containing diatoms to the slide for careful examination



A cover glass is placed over the diatom specimen and it is tightly sealed down with Canada balsam



Banded diatoms, described in the text, are here seen as they appear when greatly magnified

Diatom specimens taken from the mud of a pond are boiled in acid and rinsed before being mounted

NATURE'S microscopic flowers excel in beauty the rarest and most exotic of our highly cultured plants. An orchid or an iris appears crude and unfinished by comparison with the intricate and fascinating pattern of a diatom as seen under a microscope.

Nearly everyone has heard of diatoms and knows vaguely that they are tiny plants too small to be seen by the unaided vision. Few realize however, that this widely scattered and prolific family can be found in a vast number of forms, each of which is endowed with almost unbelievable beauty. Thrilling adventures and sights undreamed of await the owner of a little microscope having a magnifying power of from 300 to 350 diameters.

So large and luxuriant is this garden of nature that scores of men have made it their life work to study and classify the things they found in it. More than 10,000 different kinds of flowers have been discovered and classified in more than 1,200 species. The work still goes on. In no other field can the microscopist find such variety of form and color. One diatom may resemble the steering wheel of your car; another may suggest an intricate ladder, and a third look like a series of delicately forged gratings.

The diatom grows wherever there is moisture and light. Aside from this, it has no particular habitat. It is found at the seashore, in the bottom of creeks and ponds, adhering to moist rocks and marine plants, and even in the bottom of a mud puddle that has been exposed to the rays of the sun.

Nature, jealous of the consumate beauty of the diatom, has embalmed it in a sort of majestic sarcophagus, in which it is preserved for long periods. As a result of this strange fact, many of the diatoms we shall examine flowered and died millions of years ago. This sarcophagus is composed of a hard, flintlike compound of silicon. Ordinary sand is such a compound.

IF THE bottom of a large puddle, several weeks old, is carefully scraped some interesting diatom specimens may be found. We cannot, however, see them with our unaided eyes, for a comparatively large diatom measures only about one two-hundredth of an inch in diameter. The mud you have taken out of the puddle should be drained free of water and a small bit of the residue placed on a clean slide and carefully examined.

This search may reveal no diatom for it may be that, in the puddle you chose, none was growing. In that case, it will be necessary to find some stagnant pond or sluggish creek and scrape the bottom for mud. Not all of these interesting plants, however will be found on the bottom, for a number of the species cling to other and larger plant life that grows in water. Often scraping the underside of a marine plant will bring to light diatoms fastened to the leaves by gelatinous stalks. Those who live near the sea will undoubtedly find specimens attached to seaweed.

Once a source of diatoms is discovered, the real fun begins. Each specimen appears different from the others because of the extraordinary variety in this family. Objectives of both high and low power may be used. Indeed, many microscope enthusiasts claim that better and more exciting views of the diatom may be had with the lower powers. The writer however, would advise the use of each.

When we view a diatom with the high-powered objectives, it is necessary to focus and refocus a number of times, for the thickness of the specimen may

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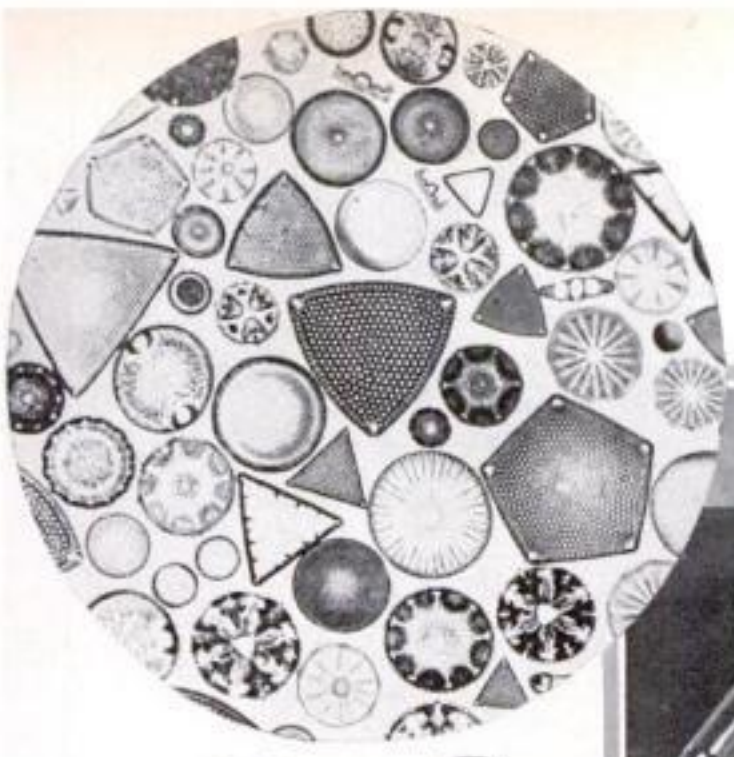
Organism in Vast Variety of Forms Proves a Fascinating Study—How to Mount Diatoms for Your Collection

By

BORDEN HALL



Fossilized forms of flowers that lived millions of years ago may be found in your tooth paste. Diatoms may be removed from the water in which they abound by filtering, as shown below

Many types of microscopes, a few of them shown on this page, are available for the amateur at a very moderate price

be such that one part cannot be brought into perfect focus without blurring another part. Thus examination is carried on progressively at different levels.

IF LIVE diatoms are discovered in the bed of a pond and we have a plentiful supply of them, it may prove interesting to place a bit of water and some of the mud in the depression of one of the special microscope slides mentioned in my article last month. Many of these marvelous little plants have the power of locomotion and we may experience the rare delight of seeing them propel themselves throught the water. Some have a rather lively motion that will carry them past our vision in a zig-zag course.

In the study and examination of diatoms, the thing that will strike us most forcibly will be the exquisite and delicate patterns of the tiny plants. It is as though a thousand great artists had been turned loose and told to draw and color a multitude of lacelike designs using every known geometrical form. The show is absolutely unending for even though we should spend a lifetime examining these specimens we could never exhaust their infinite variety.

Diatoms, that is the very old, old diatoms that flowered millions of years ago, have a number of important industrial duties. We buff our silverware and often brush our teeth with these old, but still perfectly intact, little plants. Also, in the form of kieselguhr, a fine powder, they are used as the absorbents in the manufacture of nitroglycerin and the preparation of dynamite. We also find that much of this diatomaceous earth or kieselguhr, is used in the manufacture of non-conducting materials for heat and sound resistance. This comes in the form of wall board. Hence we have wall board made of microscopic flower gardens that perished countless ages ago!

One of the world's greatest deposits of diatomaceous earth was found in Virginia. This deposit runs for a distance of many miles and in some spots is forty feet deep. As it has a mild abrasive action and will not scratch, a great deal of this earth is used in polishing and cleansing agents.

The alert microscopist does not need to suffer for want of diatomaceous earth. It may be obtained cheaply from microscopic supply houses or, in many cases, it may be found in the home. Not all tooth pastes and powders contain this excellent polisher but many of them do, with the result that these fossilized diatoms can easily be brought to the stage of the microscope. Silver polish also often contains such earth as its principle ingredient and hence contain diatoms.

EACH sample of toothpaste or silver polish examined in the search for ancient diatoms, must first be dissolved in a small amount of water. The excess water is then filtered off through very fine cloth or by means of chemical filter paper. The residue is transferred to a clean slide and placed on the stage of the microscope. Two or three drops at a time is sufficient. As the slush is examined, the worker moves it about with the needle that was described in the first installment of this series. As he does this, the microscopist will feel very much like the archaeologist who delves into old ruins seeking the artifacts and records of ancient life. The ruins which the microscopic worker wanders amidst, however, are far older than any ruins that men have left for the archaeologist.

IN CULLING through these botanical graveyards, one of the low-powered objectives may be used since in this way the area of examination is increased and the search speeded up. After interesting specimens have been found, the objective may be changed for one of higher power. This will bring out details and reveal to us the strange fact that these million-year-old diatoms were no different from those living today. Indeed, one can find diatoms exactly like them at the bottom of any stagnant pool.

Let us take a good look at a living diatom. For this purpose a drop of water must be used. No diatom can exhibit natural habits unless placed in water which is its natural environment. Examine it first with *(Continued on page 87)*

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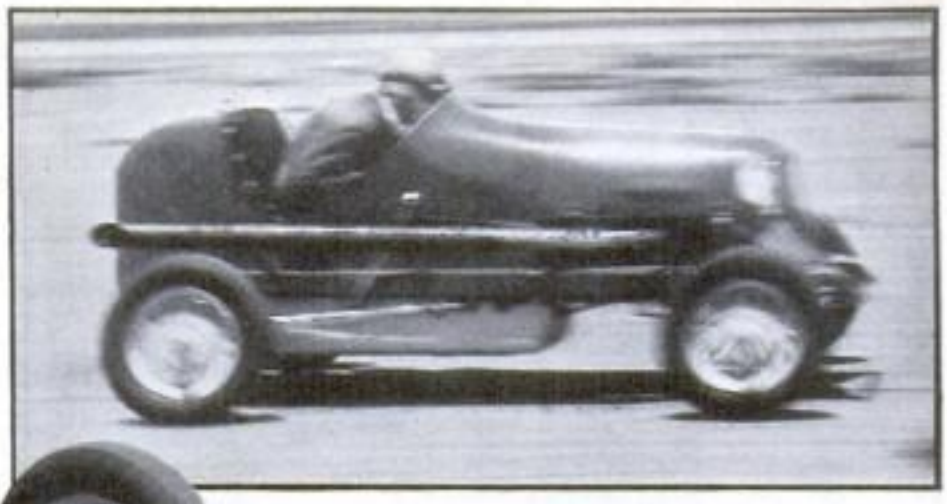
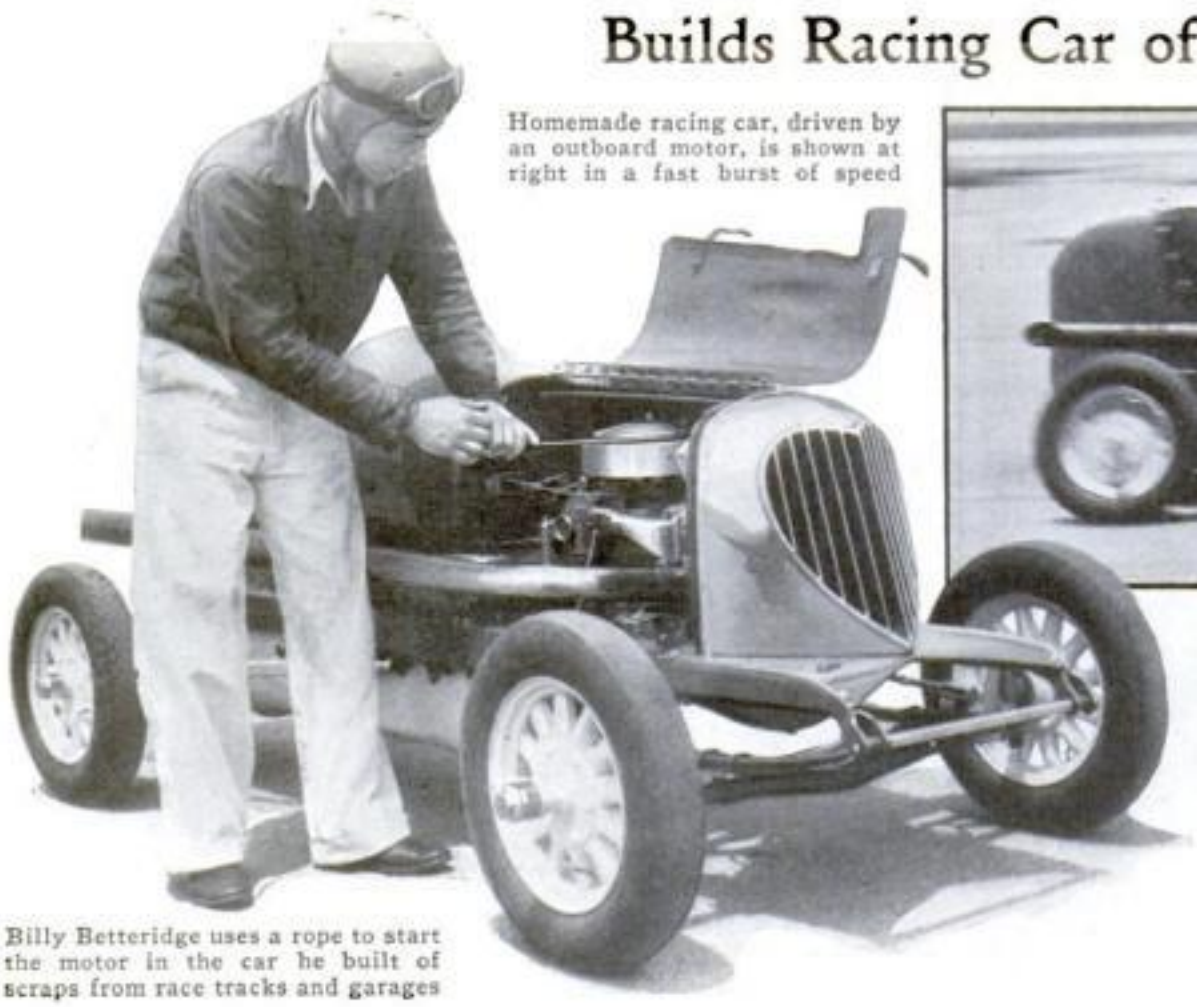
Builds Racing Car of Discarded Scraps



Homemade racing car, driven by an outboard motor, is shown at right in a fast burst of speed



Billy Betteridge uses a rope to start the motor in the car he built of scraps from race tracks and garages

WHEN Billy Betteridge, eighteen, of Los Angeles, Calif., built his own racing car, odds and ends from race tracks and garages provided his material. For the motor, he took a twenty-two-horsepower outboard model from his boat and installed it under the hood. Propelled by this unconventional power plant, the tiny racing car is reported to have attained the remarkable speed of 100 miles an hour in tests. The motor is so fitted that it may be removed and replaced in the boat.

DETACHABLE PARACHUTE HAS LIFE BELT

Above, left, flyer with parachute and life belt is falling to earth. At upper right, 'chute is released before striking water

The parachute has drifted away and the flyer is seen, right, supported by self-inflating life belt

To REDUCE the hazards for aviators who are forced to leap from their machines over water, a new combination parachute and life belt has been successfully tested at a lake near Berlin, Germany. The device is designed to overcome the danger of a parachute jumper becoming entangled in his 'chute after striking the water, with the result that even a good swimmer may risk drowning. Just before plunging into the sea, the airmen operates a release that frees him from the 'chute. Remaining attached to him, however, is a life belt containing chemicals that inflate it with carbon dioxide gas as soon as it is touched by water. In this manner the airman is kept safely afloat until rescuers reach him. During the recent tests, a self-inflating float was attached to the parachute to facilitate its recovery from the lake.

MOTORISTS GET HOURLY REPORT ON WEATHER

MOTORISTS of Cleveland, Ohio, need not worry about the weather when they plan their automobile trips, as the city's auto club recently installed a teletype weather report service. A machine, similar to those used by air lines, receives hourly weather reports from 200 government stations in various parts of the country. These are recorded on a tape, so that a prospective traveler, consulting the service as illustrated above, will be informed whether it will be stormy or clear.

POPULAR SCIENCE HAS WORLD'S FAIR EXHIBIT

SCORES of animated models portray the fundamental triumphs of human ingenuity at POPULAR SCIENCE MONTHLY'S exhibit at Chicago's World Fair. Basic inventions that have paved the way for mankind to harness the forces of nature, from the lever and pulley to the intricate workings of the internal combustion engine, are arrayed for your inspection in this mechanical wonderland. The exhibit is in the Pavilion of Industrial Engineering in the General Exhibits Building.

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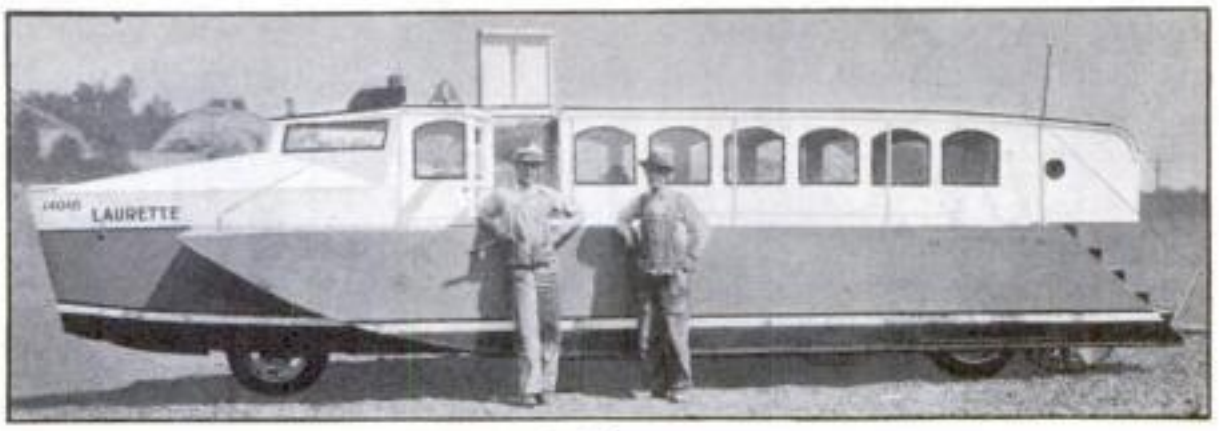
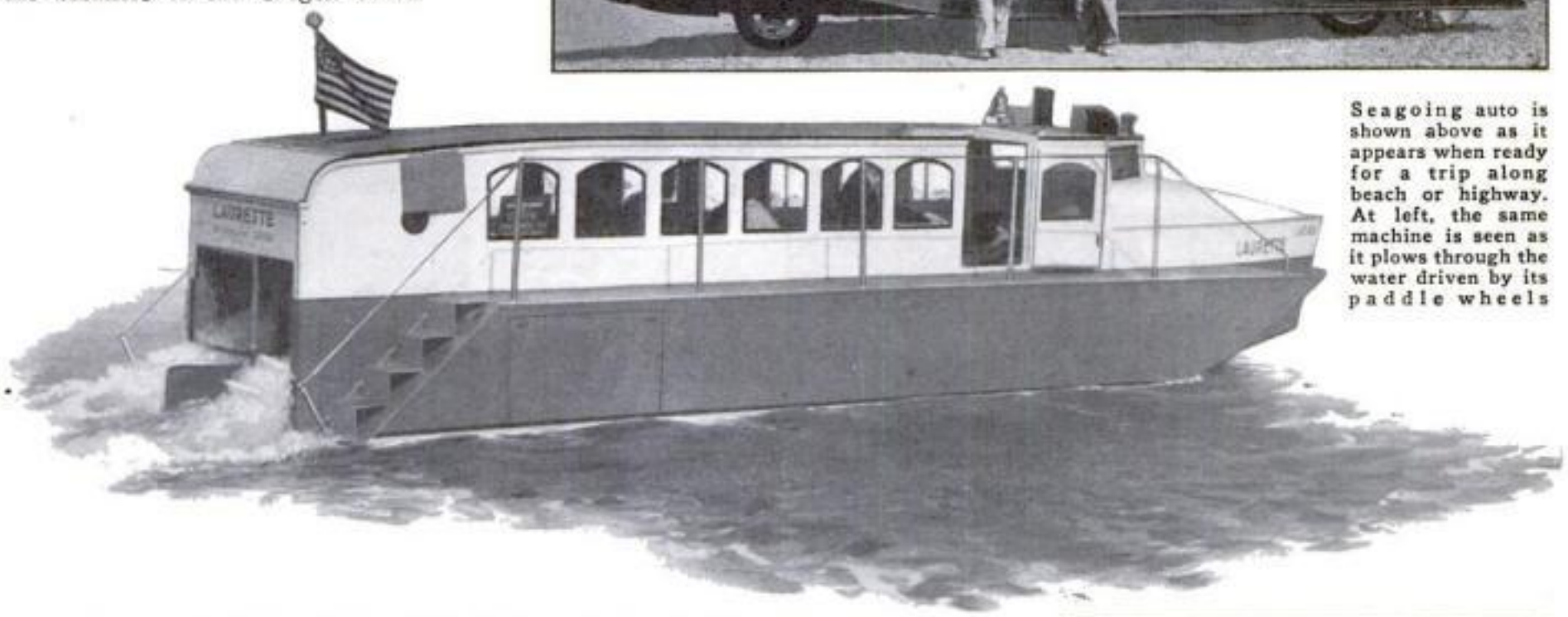
Seagoing Auto Runs on Land or Water

A SEAGOING automobile recently completed a thirty-hour water trip by crawling ashore on the beach at Seaside, Ore., where it will serve as an amusement device for summer bathers. The unusual machine travels with equal ease on land or water, using paddle wheels for aquatic propulsion, and accommodates a dozen passengers for a twenty-minute sea trip through the breakers of the Oregon coast.





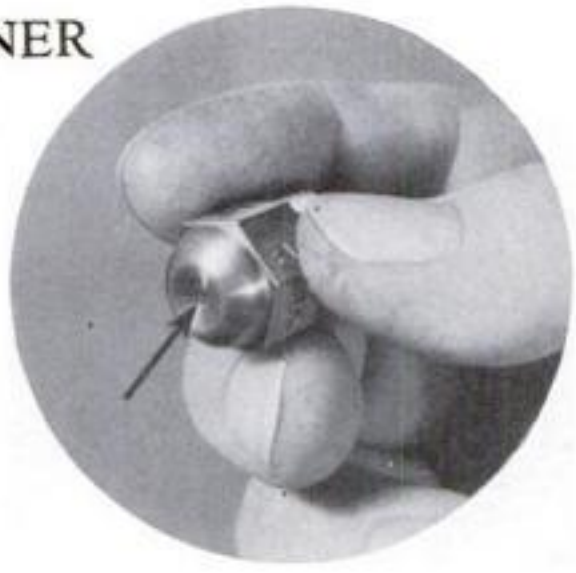
Seagoing auto is shown above as it appears when ready for a trip along beach or highway. At left, the same machine is seen as it plows through the water driven by its paddle wheels

NEW KIT FOR WOOD INLAYING

INLAYING with wood is made easy for the novice by a new kit, containing complete materials for a tray, cigarette box, or inlaid checkerboard. The object to be decorated is furnished, together with precut inlay pieces and borders of the proper shape, prepared to be assembled with glue. Natural woods, sliced to a thickness of only one eighty-fifth of an inch and backed by muslin, are used for the inlays.

DIAMONDS IN OIL BURNER

OIL burners are now being fitted with diamonds. Certain types of burners atomize their fuel by spraying a jet of air and oil, under pressure, from a tiny orifice, which may fail to give satisfactory performance if it becomes misshapen from wear. When a dark-colored diamond of industrial grade was pierced with a hole of proper size and fitted in the nozzle, at the point shown by the arrow in the photograph, tests proved that its great hardness enabled it to resist wear even when abrasive powder was mixed with the oil. In consequence, oil burners with nozzles equipped with these tiny diamonds, have now appeared on the market.



AIR-DRIVEN AUGER BORES POST HOLES RAPIDLY

RESEMBLING a huge wood auger, a new portable air drill makes it possible to dig post holes in record time. Revolving more than one hundred times a minute, the air-driven cutter can drill a hole three feet deep and fifteen inches in diameter in less than six minutes. A small, self-locking winch, attached to one leg of the driller's collapsible tripod, makes raising or lowering the cutting head a simple one-man job. The illustration above shows the drill as it appears when in action.

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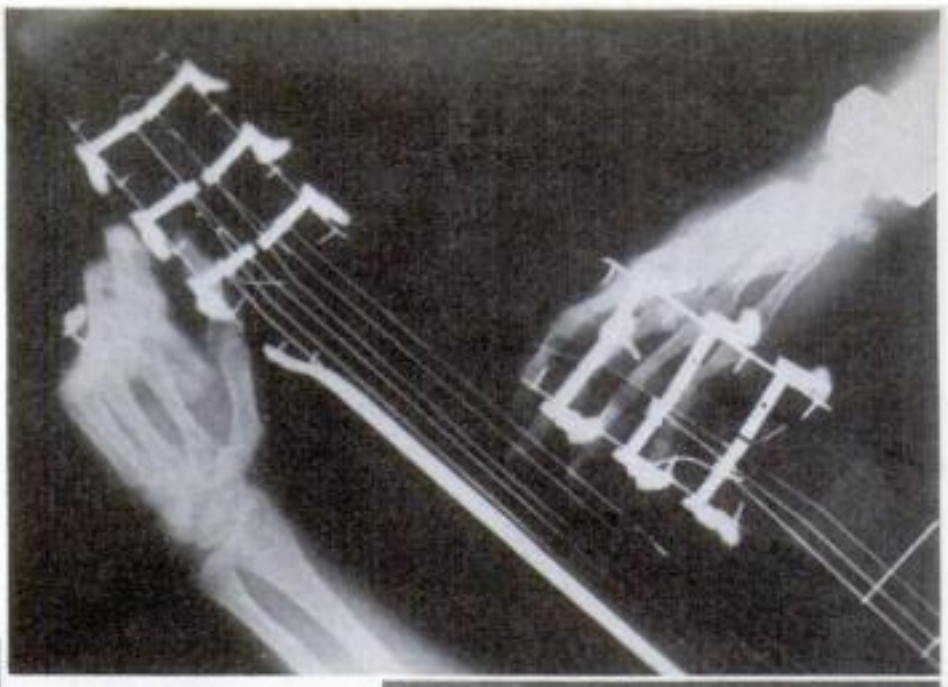
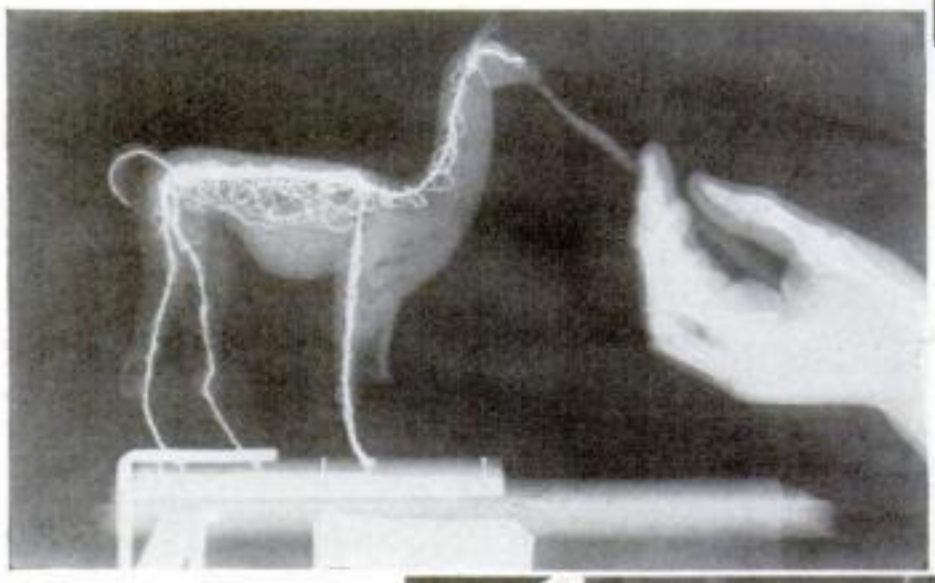
Strange Scenes from Life Caught with

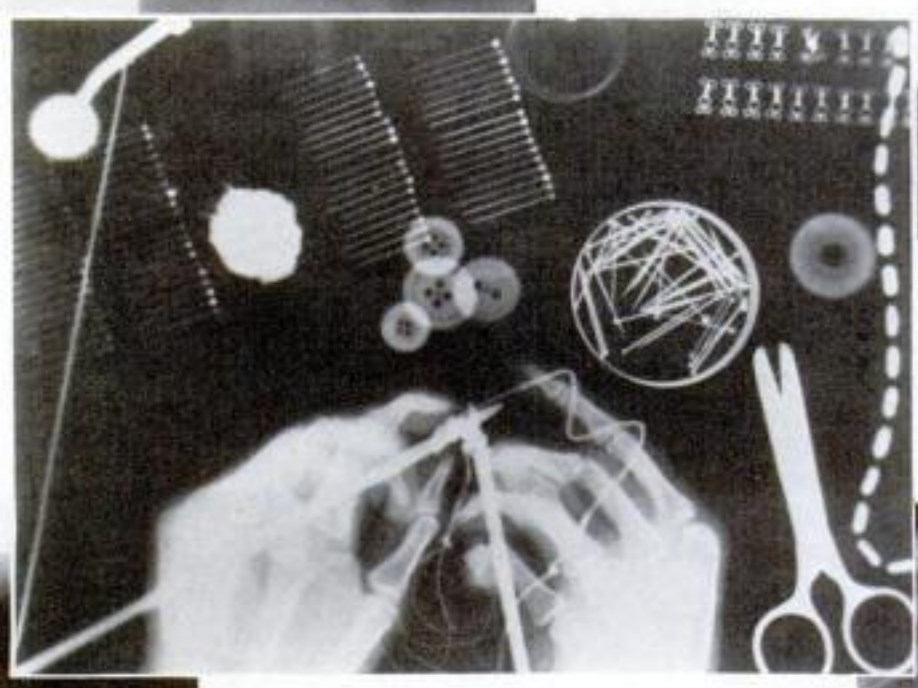
X-Ray Camera





X-ray photography, widely used in medicine and industry, is familiar to almost everyone in its ordinary applications. Recently a German physician has busied himself making X-rays of everyday scenes. Pictures on this page show the result of his hobby. Above, the hand of a sculptress modelling the clay figure of a llama. Note that the wire framework on which figure is built up is seen as white lines

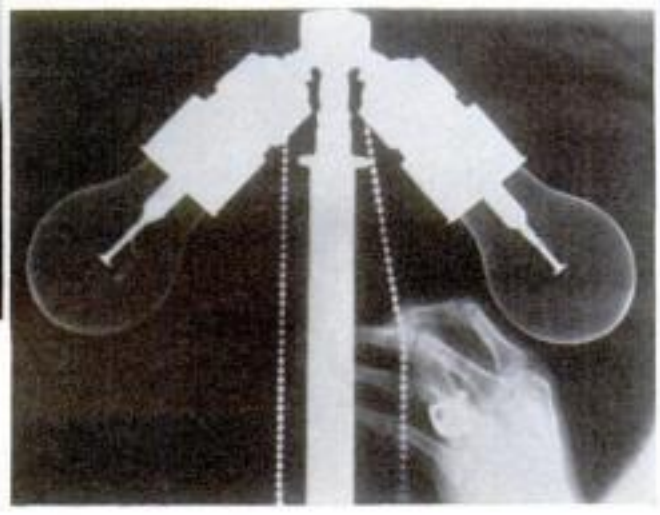
Skeleton hands, above, appear to be playing some weird stringed instrument. The whole picture has a ghostly atmosphere of unreality though it is quite a commonplace scene. It merely is a musician stringing his guitar, at the right, and, at left, tuning it



This is the way skeleton hands would look if they were photographed in the act of driving a nail into a door. Note that the handle of the hammer is barely visible though its head is plainly seen. Photo gives a good view of the bones

You may have trouble determining the meaning of this picture. Actually, it shows the arm of one woman and a little of the arm of her companion. The metallic handbag, its chain, and a bracelet obviously were not penetrated by X-rays

There are so many metallic things in this picture, that its character is easily discovered. The hands of a knitting woman are shown, together with needles, pins, scissors, hooks and eyes. Note that the yarn around the hand shows plainly and that the semi-transparent objects, like the buttons, are more prominent at the point of overlapping



The X-ray gives a strange view of the lady who is about to be served with a cup of tea poured from the teapot. She is sitting with knees crossed and is wearing a finger ring

Apparently there is no shade on the table lamp, left, which is about to be lighted. Actually, the X-rays passed right through the shade but did not penetrate the sockets or the chains

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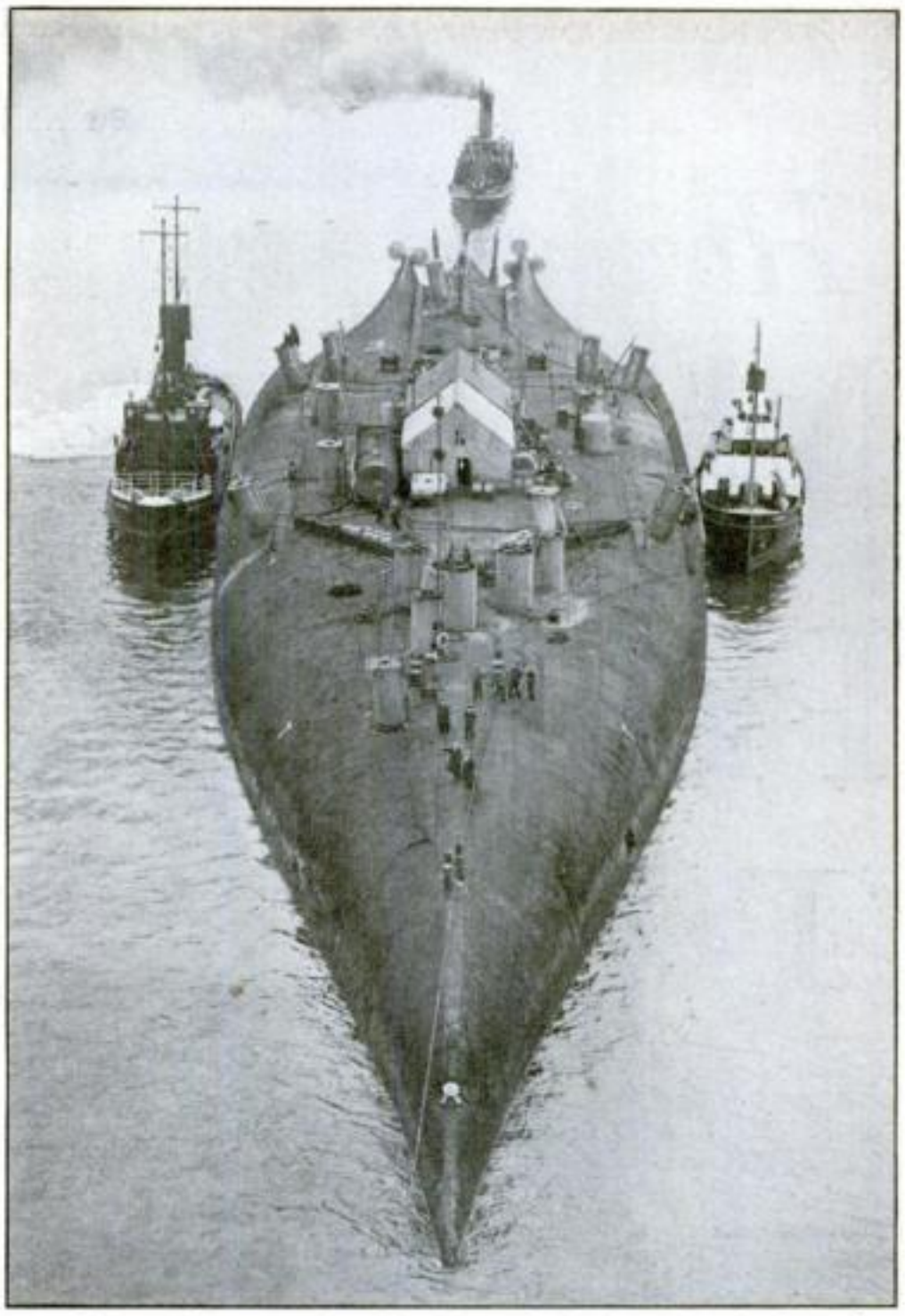
Ship, Raised from Sea Floor, Brought in Bottom Up

BOTTOM up and manned by a small army of workmen, the salvaged cruiser, *Prinz Regent Luitpold*, recently made a striking sight as she arrived at a Scotch port in the tow of tugs. The vessel was one of the German warships scuttled at Scapa Flow by their own crews after their surrender to the Allies, and rested for more than a decade on the sea bottom. The objects resembling pipes, visible on the hull in the picture at right, are emergency exits and entrances arranged for the purpose of letting the laborers in and out of the big hull.



Salvaged German cruiser, *Prinz Regent Luitpold*, sunk at the close of the World War, is being towed, bottom up, into a dock for repairs

SPARK PLUG, ONE STORY HIGH, EXHIBITED AT WORLD'S FAIR

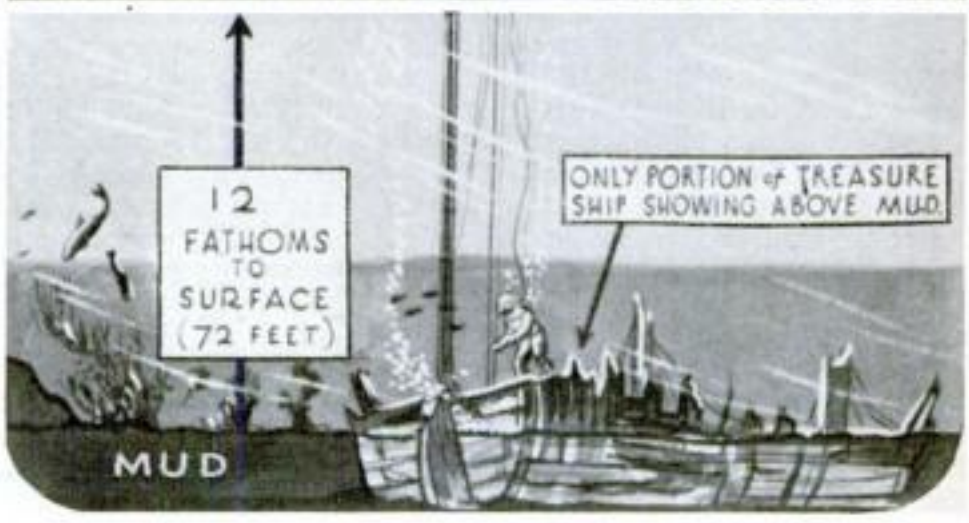
ONE of the striking industrial displays at the Century of Progress Exposition, at Chicago, consists of a spark plug one story high. The huge exhibit was built to scale and realistically colored. Engineers have calculated that an automobile, built large enough to use the giant plug in its ignition system, would be nearly two blocks long, and would measure more than 200 feet from its top to the ground.

Since no attempt will be made to electrify and fire the monster plug, visitors at the fair may safely examine its construction and learn how it does its work.

Spark plug, one story high, now on exhibition at Chicago. Girl standing on it suggests plug's size

Suction Pipes to Recover Spanish Gold from Ancient Wreck

SUBMARINE treasure hunters are preparing for an attempt to recover $40,000,000 worth of Spanish doubloons, that went to the bottom of the sea off Cape Henlopen, Del., in 1798 when the British ship *De Braak* was sunk. Suction pipes will be used to bring the coins to the surface. These pipes are shown at the left. Below are the expedition's ship and a diagram of the salvage plans.



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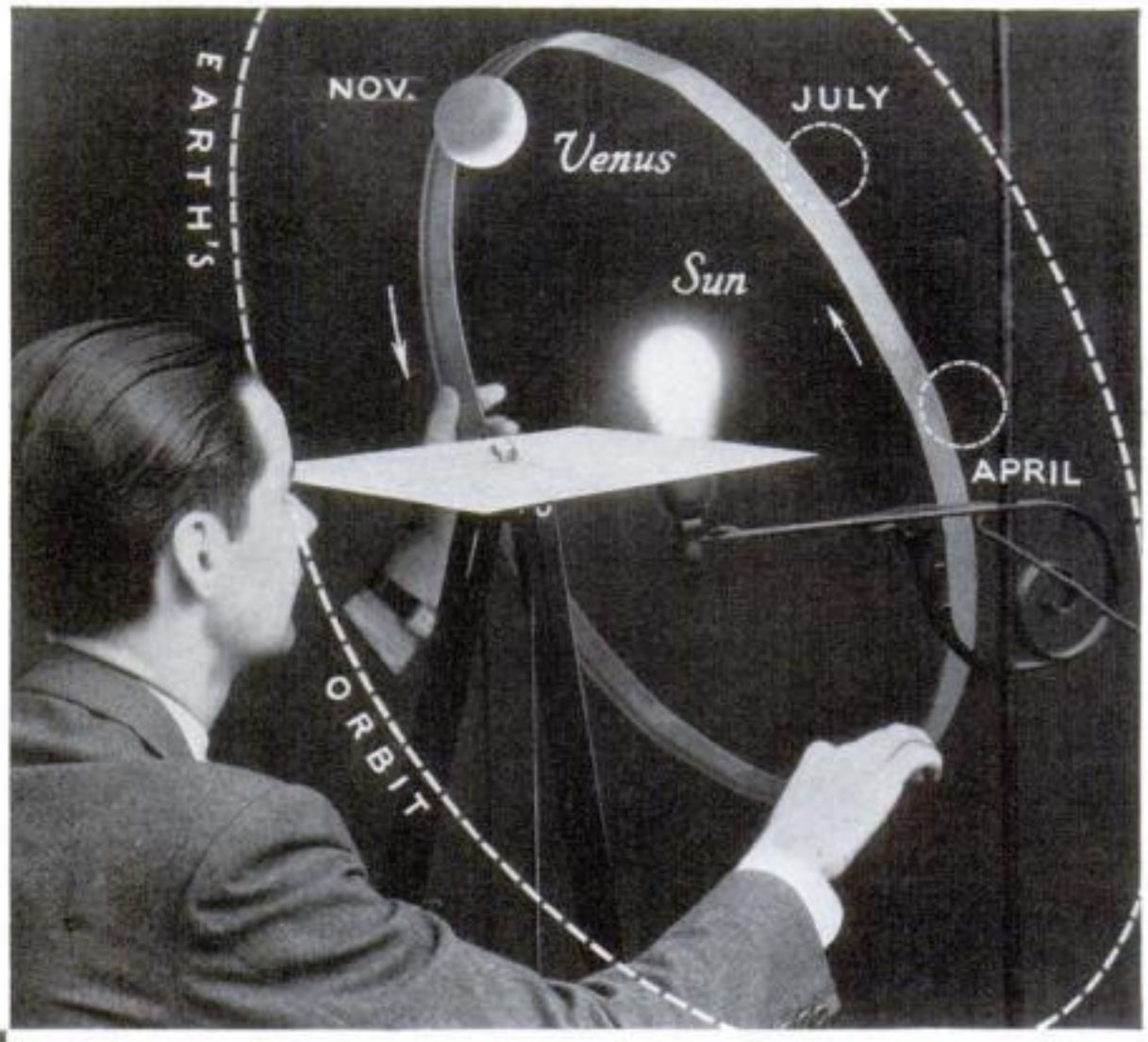
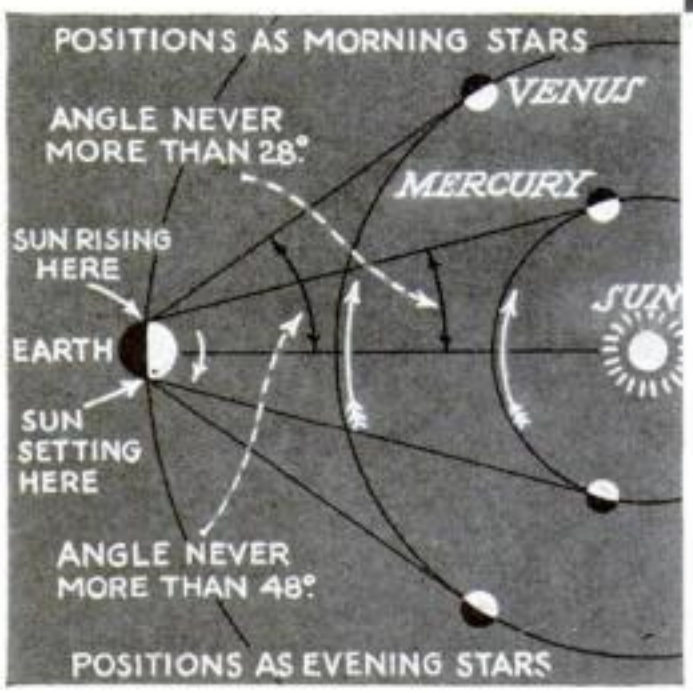
A Barrel Hoop *and a* Tennis Ball *show*...

How the Moon *and* Planets *Travel*



The barrel hoop and tennis ball represent Venus and its orbit around the sun whose place is taken by the lamp. Turning the hoop, as indicated by the arrow, brings Venus up from its position in April through its phases, shown in the little diagram at right, to its point of descent in November. Study of diagram, left, will show why Venus and Mercury are evening and morning stars. It also shows their angular distance from the sun



THERE will never be a better time than this month and next to watch the steady progress of the planets along the sky road which we laid out across the heavens last month.

Any evening during July, you can find Venus, Jupiter, and Mars in the western sky after sunset. Once you have become familiar with the characteristic appearance of each, you can no more confuse these planets than you could mistake different makes of automobiles seen along a road.

Let us turn to the sky now and find the position of Mars, Jupiter, and Venus. Then we shall have this brilliant trio spotted for observation during the succeeding summer evenings.

If you look at the western sky just after sunset on July 15, you will see Mars and Jupiter between the fixed stars, Spica and Regulus, which you have already learned to find. (P. S. M., June, '33, p. 42.) Venus will be lower than Regulus. On this date you may also catch sight of Mercury far down toward the horizon in the red haze where the sun recently vanished. For an evening or two after the fifteenth, you may see Mercury setting immediately after the sun. Your best chance of seeing this planet, however, will be earlier in the month, as soon as possible after July 2, if the evenings are clear.

About August 17, just before sunrise, you can again see Mercury in the eastern sky. Then he again dodges into the sun's rays and vanishes for the rest of the summer. The beginning of July and the middle of August are the only periods at which you will be able to see Mercury this season.

You remember that the fixed star Regulus, in the sickle-shaped group of stars forming part of the constellation Leo, marks one point on the stars' race course. On July 15, you will find Regulus in the southwest, about thirty degrees above the horizon where the sun has set. Upward about fifty degrees to your left, near the meridian, you will see Spica, the other point on the planets' path, or "ecliptic." (P. S. M., July, '33, p. 40.) Mars is nearer Spica and Jupiter is nearer Regulus. With these data, you hardly can fail to find them instantly, especially if you remember that Mars is the red planet.

To make plain the movements of Venus and Mercury, I cut a slit in an old tennis ball and stuck it on the edge of a barrel hoop. The lighted bulb of a bridge lamp was placed level with a piece of cardboard fastened upon a camera tripod. The cardboard represented the western horizon. When the hoop was held as shown in the accompanying illustration and turned slowly to the left, the lamp illuminated the ball exactly as the sun lights up Venus, and thus I was able to see Venus climb the sunset sky and sink again.

The same experiment explains the movements of Mercury, only now the hoop should be much smaller and its rotation much faster, for Mercury is only 36,000,000 miles from the sun and rushes around his orbit in eighty-eight days, while Venus takes 226 days.

The little diagram of the paths of the two planets shown in the first column of this article, explains why each plays the part of a morning and evening star, appearing in the west after sunset, in the east before sunrise, and disappearing in the sun's rays when passing behind or in front of him in their orbits.

The disappearance and reappearance of Venus led the ancient astronomers to believe that it was two different planets, which they named Phosphorus and Hesperus. Pythagoras, a Greek scientist of the sixth century B. C., finally discovered that the seemingly two planets were in reality only one.

Another acrobatic stunt of the planets, which for centuries was a great puzzle to

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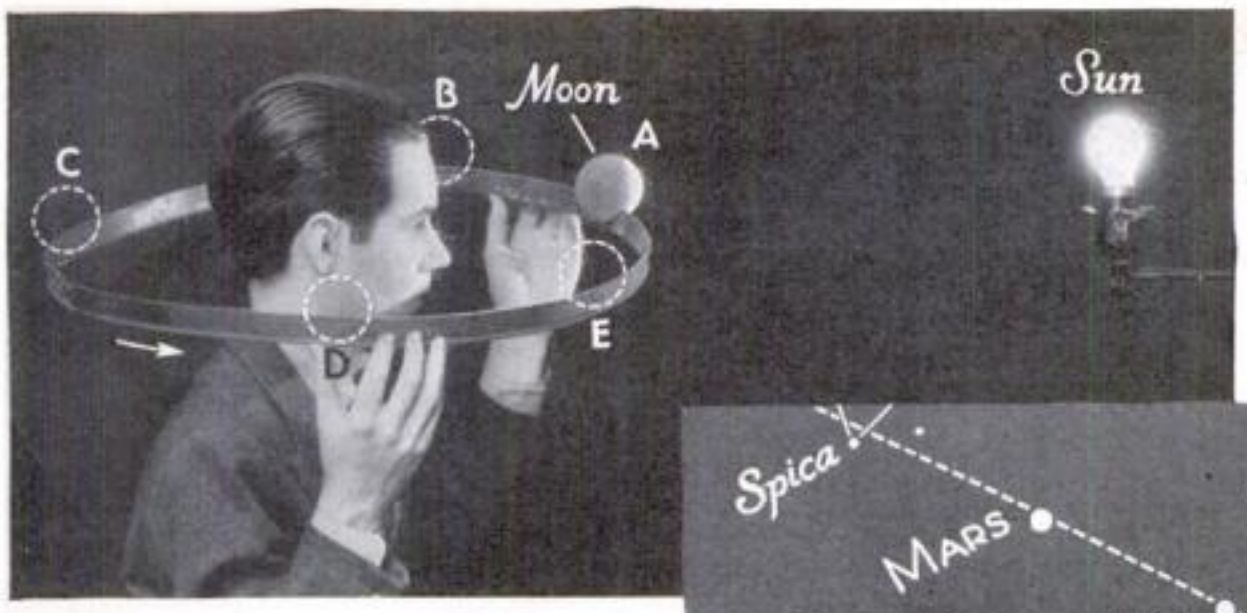
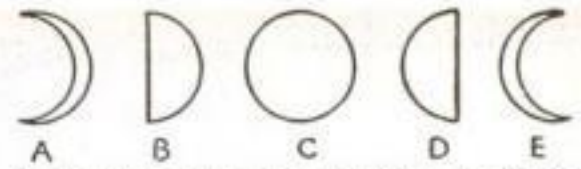
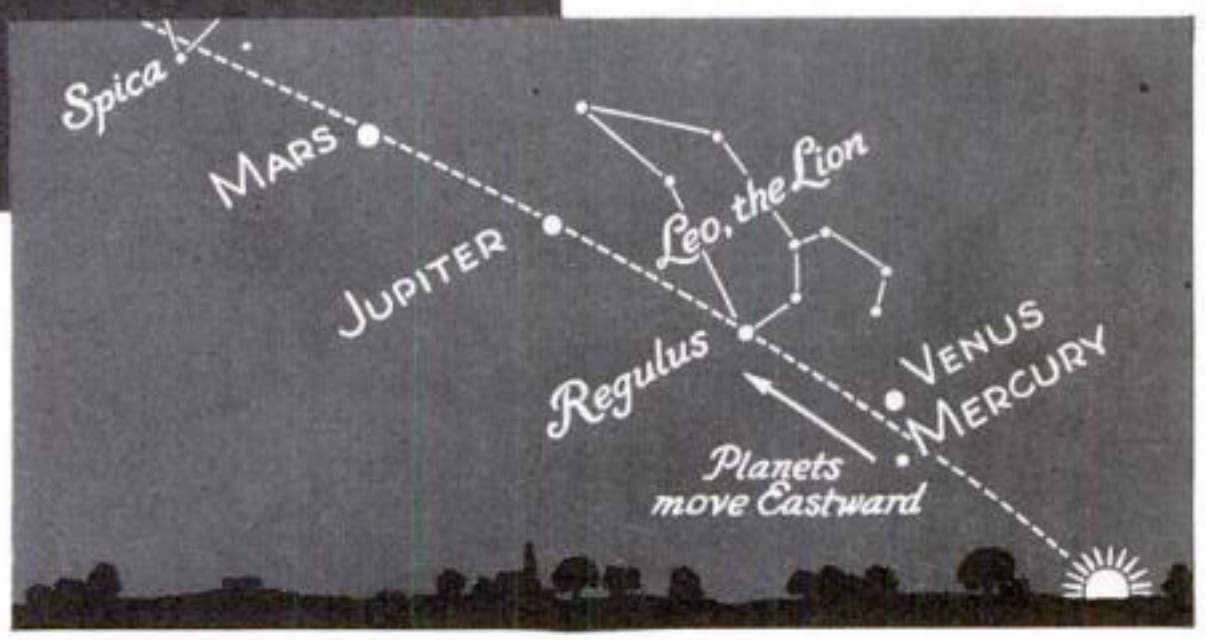




In the illustration, left, the lamp is the sun, the ball is the moon, and the hoop is its orbit around the earth. As the observer turns with the hoop and ball as arrow indicates, he will see the moon go through all its phases as shown in diagram above. The sketch below shows how the fixed stars Spica and Regulus are used as sign posts to find the position of Mars and Jupiter



MORE INTERESTING FACTS ABOUT HEAVENLY BODIES

By

Gaylord Johnson

astronomers, is the loop the loop which each member of our solar system apparently goes through while following its orbit.

For instance, this is what happens to Mars, when he is on the same side of the sun as the earth:

After traveling steadily in his course for many months, he gradually slows down, seems to stand still, and then appears to go backward. After about three months of this backward, or retrograde motion, he again apparently gradually stops and then once more begins his forward march.

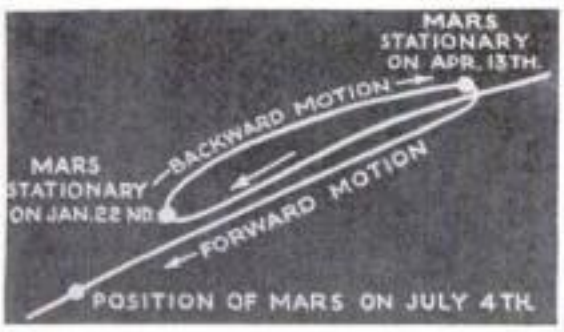
Ancient astronomers found this evolution of Mars difficult to explain. It puzzled them because their whole idea of our solar system was wrong. They believed that the sun and the other planets revolved around the earth as a center. To us, who know that the sun is the hub of the wheel, the movements of the planet are easily understood.

The effect is the same as the one you notice when riding in a railroad train that passes one moving more slowly on another track. While your train is passing, the other seems, for a moment, to be moving backward.

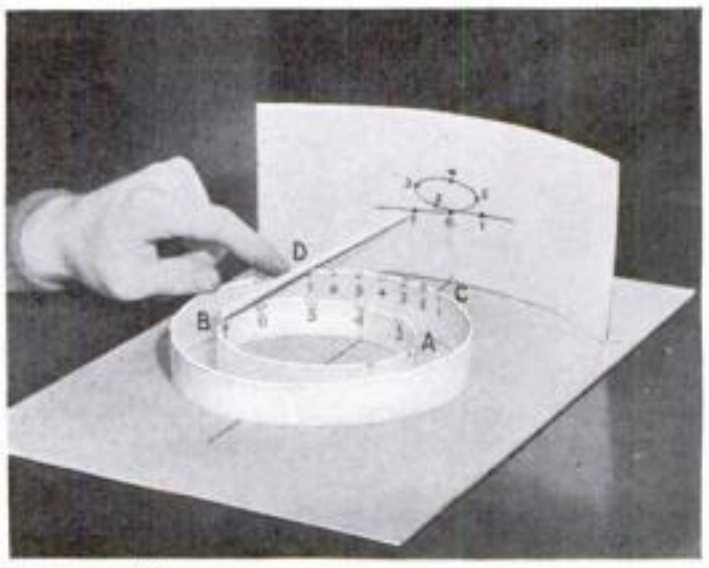
Now substitute the earth and Mars, in their orbits, for the two trains. Let the background of the fixed stars take the place of the landscape. The earth, going around the sun in one year, is the faster car, for Mars takes one year and ten months to make the circuit. When Mars is on the same side of the sun with us, there is a race which the earth always wins. While the earth is passing Mars, the red planet seems to move backwards as viewed against the fixed stars.

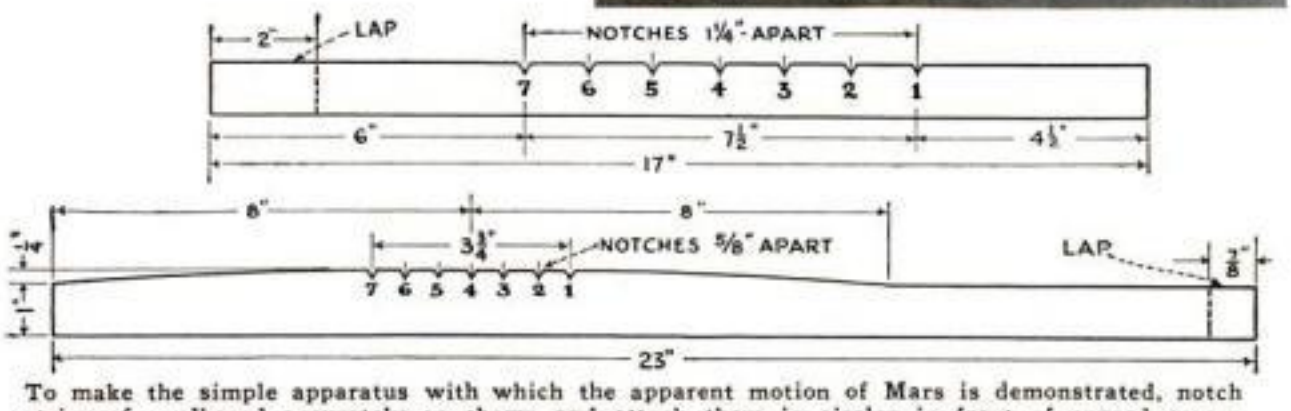
The little diagram on this page explains the formation of Mars' loop. You will notice that Mars' path is made a little wider on one side, causing a slight slant in the orbit, as is the case in reality. The planes of the earth's and Mars' paths slant slightly to each other. This causes the apparent place of Mars to rise and fall as it proceeds, retrogrades, and advances again, thus producing the appearance of a loop in its path.

Why Mars Appears to Stop and Then Loop the Loop



The apparent motion of Mars, due to the swifter advance of the earth, is shown in diagram above. Right, a pointer, set in notched cardboard, is used to trace Mars' loop on a curved screen. This explains a mystery that baffled the old astronomers





To make the simple apparatus with which the apparent motion of Mars is demonstrated, notch strips of cardboard accurately as shown and attach them in circles in front of curved screen

In order to build a model with which to demonstrate the formation of this loop, make bristol board strips for the rings, from the measurements given in the diagram, and pin them to a stiff piece of cardboard. Any straight strip of cardboard will do for the pointer. The size of the curved screen, on which the loop is drawn through the successive positions indicated by the pointer, is not important, but the strips and notches should have the exact measurements shown.

About July 24, you can begin an interesting experiment with the aid of the crossbow rule which you made for measuring the angular distance between the fixed stars. (P. S. M., June, '33, p. 42.)

When the crescent of the moon makes its first appearance in the western sky July 24 or 25, take your crossbow rule and place the end at the moon and let the rule extend to the left in a direction at right angles to a short line joining the horns of the moon's crescent. The rule will then lie along the moon's path among the stars. You will notice that the edge of the rule will cross your old signpost, the star Regulus. *(Continued on page 85)*

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Handy Kinks

FOR THE HOME

THINGS YOU CAN MAKE. With material found in every home, the conveniences pictured on this page can be made with little trouble and at practically no cost. For instance, a card table, with two legs, left, folded, makes a handy accessory for the sick room. It then slips over the side of the bed as is shown

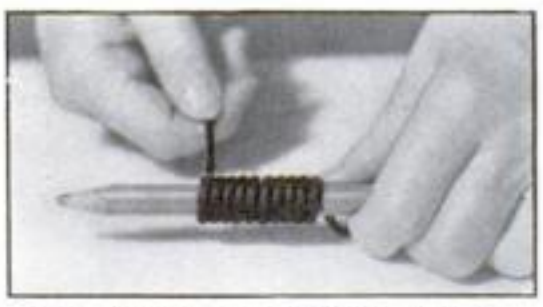
TO TAKE OUT A PUSHED-IN CORK When a cork has been pushed inside a bottle, grease the bottle neck and hold the bottle under cold water for a few minutes. Spear the cork with a hatpin, steel knitting needle, or a wire and draw it up into the bottle neck. Place the bottle in a basin of hot water. Expanding air will then expel the sticking cork

USES FOR HALF OF RUBBER BALL. A good holder for loose steel wool is easily made from half of a hollow rubber ball. In this way the hands are protected and the wool cannot get beneath the finger nails. Half a rubber ball can also be used around a brush, as shown, to keep paint from running down handle

ERASER CLEANS KITCHEN RANGE. With a felt blackboard eraser, grease is readily absorbed from a stove. An eraser also serves as a polisher

SAFE NIGHT LIGHT. Stick a nail in the bottom of a small candle end and put it in a glass of water. The candle floats and can be left burning

BELL ON BOTTLE SOUNDS WARNING. Bottles containing dangerous medicine cannot be taken out of chest without noticing the mistake if a bell is attached as shown. The ringing bell calls attention to danger



SHORTER LAMP CORDS. To take up the slack in a floor lamp cord, wrap cord around a pencil forming a coil as shown. When pencil is removed, the cord remains coiled and is shortened

HIDDEN LIGHTS ILLUMINE MUSICAL INSTRUMENTS

MUSICAL instruments glowing in the dark with diffused light have been introduced to provide a novelty for theater-goers. As the musicians play, the moving light on their instruments offers a striking spectacle. This is enhanced by changing colors in the illumination, which is controlled from apparatus offstage. The photograph above shows how the scheme is applied to a violin, which is studded with concealed electric lights. The bow is also illuminated; a long tubular lamp serves as the frame. Trailing wires lead from the performers' instruments to the switchboards where lights are managed.

GARDEN CULTIVATOR PLOWS AND WEEDS

ESPECIALLY designed for use in home gardens, a new lightweight wheel cultivator permits weeding and hoeing to be done standing up. The wheel rides over rough spots, steadying the tool and keeping the teeth working at the right height. When the wheel and handle crosspiece are removed, and the cultivator attachment is turned around, the tool is transformed into a handy little cultivator for flower beds. A plow attachment, useful for light plowing or hilling, will also turn a furrow for seeds or fertilizer. The illustration above shows the new wheel cultivator.

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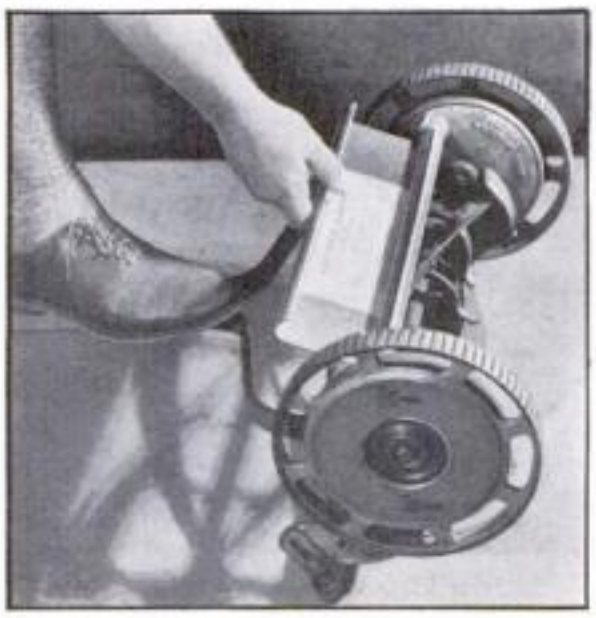
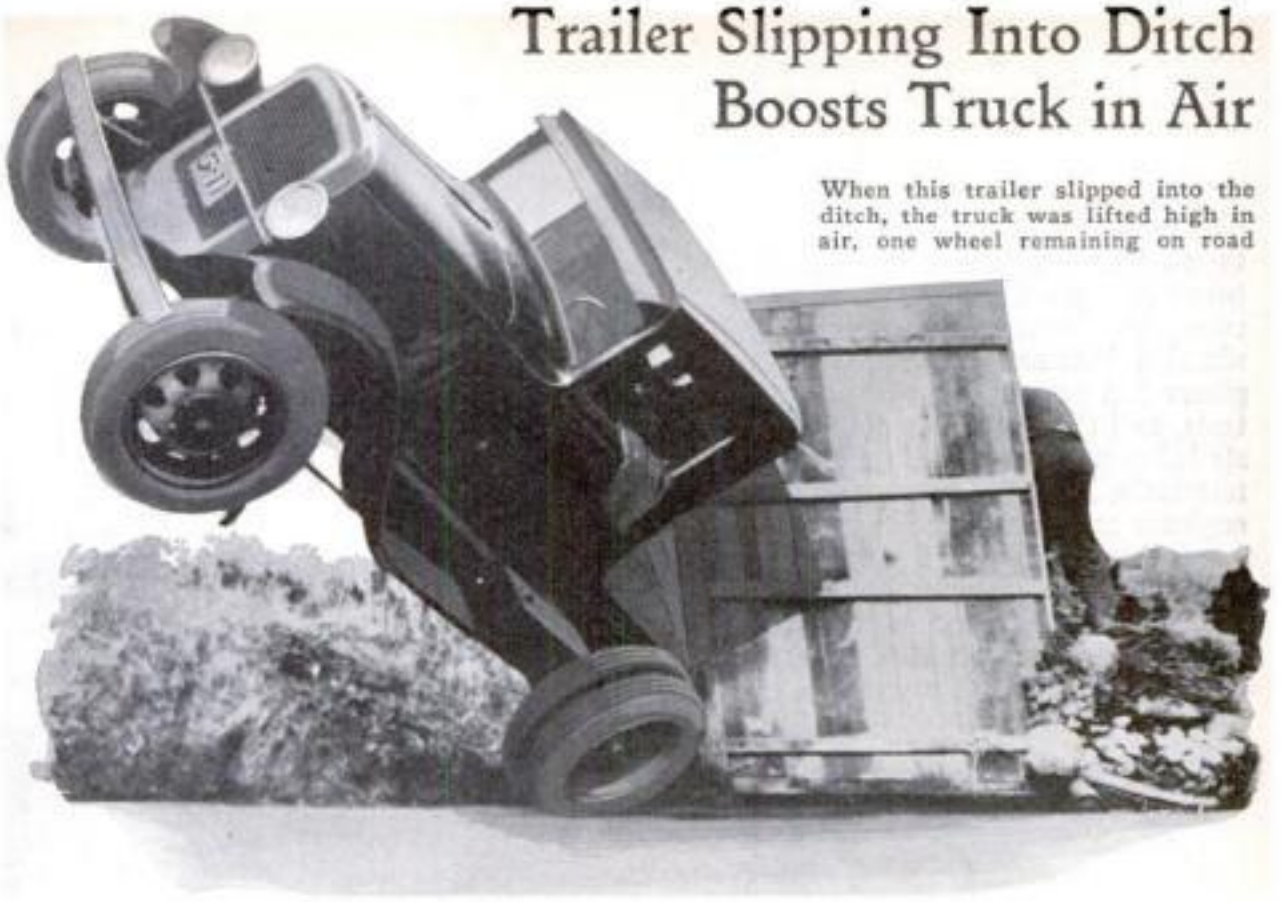
NEW ABRASIVE TOOL SHARPENS LAWN MOWER

SHARPENING the family lawn mower is made easy by a new abrasive tool. With the mower raised from the ground, the sharpener is slipped over the crossbar and held with one hand while the other revolves the mower blades against the abrasive. Only a few turns are necessary, it is said. If the mower is too wide for the sharpener to engage the entire blade at once, the tool is simply slid back and forth while the blades are turned.



New abrasive tool slips over crossbar of lawn mower to sharpen revolving blades

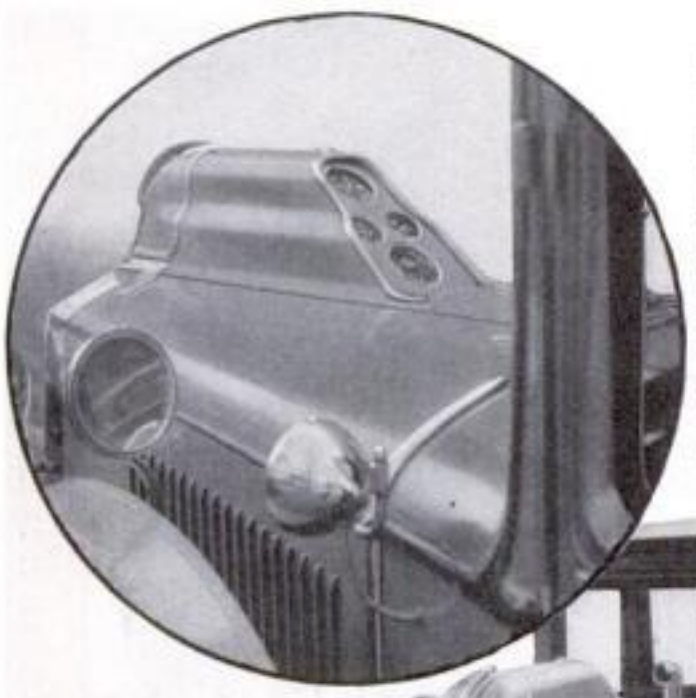
Trailer Slipping Into Ditch Boosts Truck in Air



When this trailer slipped into the ditch, the truck was lifted high in air, one wheel remaining on road

WHEN the driver of the machine pictured above felt his cab rising slowly from the earth, he might well have wondered whether he were piloting a truck or an airship. The freak accident occurred near Kipton, Ohio, when he stalled on a hill, the brakes failed to hold, and the trailer backed into a ditch. Its heavy, unbalanced load raised the truck into the air, leaving only one wheel on the ground. The astonished truckman lost no time in opening his door and jumping out.

INSTRUMENTS PUT ON AUTO'S HOOD



So HE can read the dials of his car's instruments without taking his eyes from the road, a Binghampton, N. Y., engineer has redesigned his car and placed them on the hood. A streamline housing for the meters gives the car a distinctive appearance. At night the dials are illuminated by a small light on a standard just in front of the windshield. Hinges of special design are attached to the hood, enabling it to be swung clear of the instrument panel when lifted to fill the crankcase or inspect the engine.

Car's instruments, placed on the hood, are easily seen from driver's seat

The instrument housing is streamlined and dials are lighted with bulbs outsidewindshield

MASSACHUSETTS IS FIRST STATE TO BE AIR-MAPPED

BY VIRTUE of an aerial survey just completed for Harvard University, Massachusetts claims the distinction of being the first state completely air-mapped. Its entire territory is covered by a series of pictures that make an eight-foot stack when piled together, as shown in the photograph above. The views were obtained with the latest type of mapping camera, which uses multiple lenses and makes a picture resembling a Maltese cross. They were made at 15,000-foot altitude.

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Railway Engineers In Germany Now Get Orders by Radio

TRANSMITTED by short-wave radio, messages are now heard between locomotive cab and signal tower in a new German system. A two-way scheme of radio communication between yardmaster and engineer has proved successful in recent tests, and the system is now being installed at a number of German railroad terminals. Despite fog or darkness, the engineer may thus get his instructions even when running at full speed on the open track. A considerable saving of time is also reported in complicated shunting operations which require frequent orders from the yardmaster.

Interior view of the signal tower whence orders are issued. Note loudspeaker on wall

Exterior view of the German railway signal tower from which yard engineers get their orders. Left, an engineer speaking into microphone of short wave set

TALKING DUMMIES ADVERTISE GOODS

TALKING dummies, with human voices that draw a crowd's attention, have been devised for advertising purposes by a Brooklyn, N. Y., technician. The voice is supplied by a loudspeaker, connected to a hidden microphone or a phonograph pick-up. Some of the dummies represent persons prominent in public and industrial life. Thus the phonograph voice of a well-known automobile manufacturer may talk of his car's merits.

The voice of the talking dummy is produced by a concealed loudspeaker and a phonograph pick-up, as is demonstrated above. At right, the inventor of the dummy with two of his creations, one of which is made to look much like himself

BASE TOWN'S GAS BILL ON WORK OF ONE METER

ONE meter, attached to a solitary street lamp, determines the sum that the town of Petworth, England, must pay the local gas company for its street lighting. The contract is on the basis of a certain rate per lamp, per month. The lamp measured gives the average consumption. The meter's reading, shown being taken above, is multiplied by the total number of lamps.

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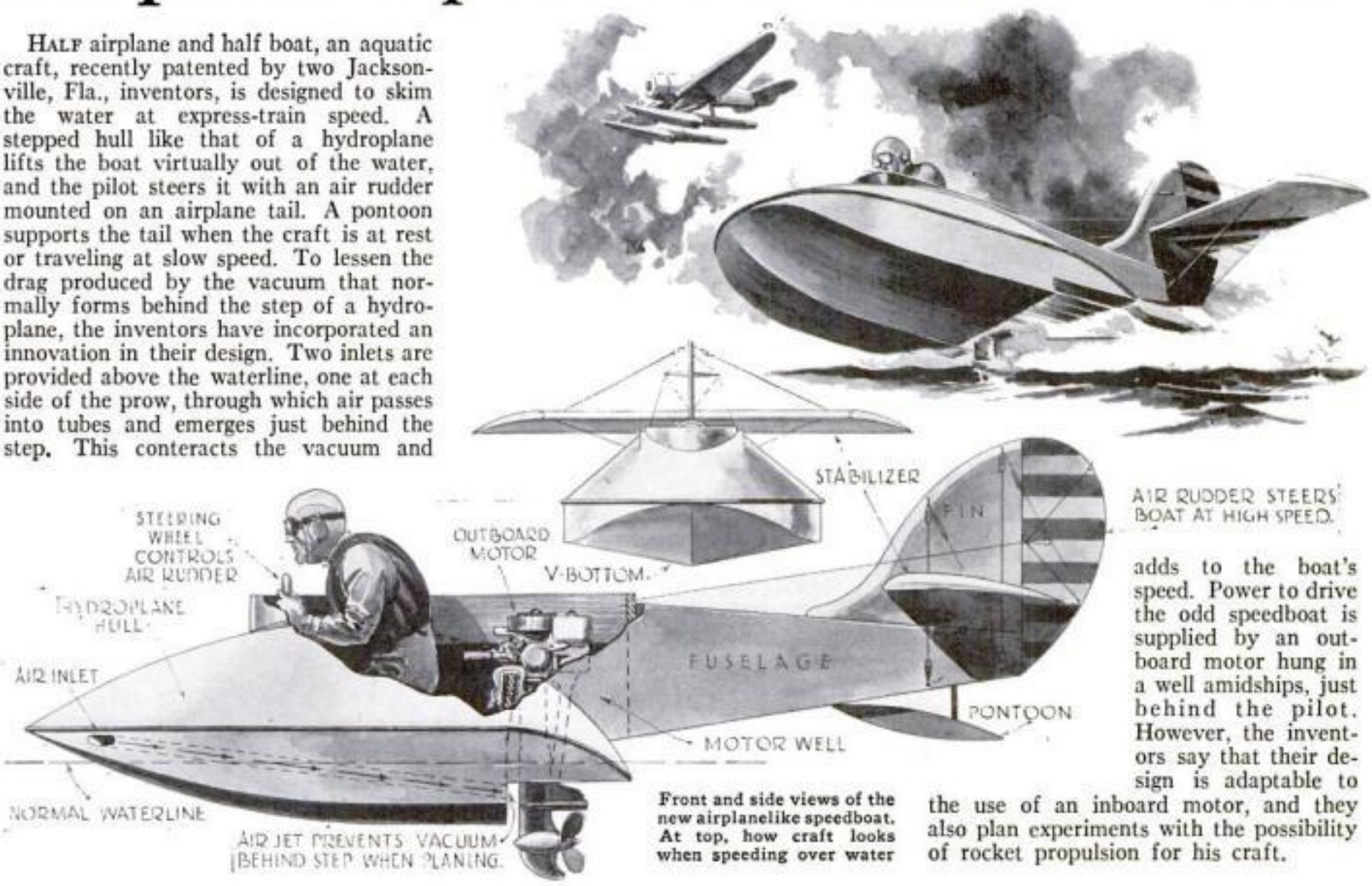
Airplane Speedboat Skims Water

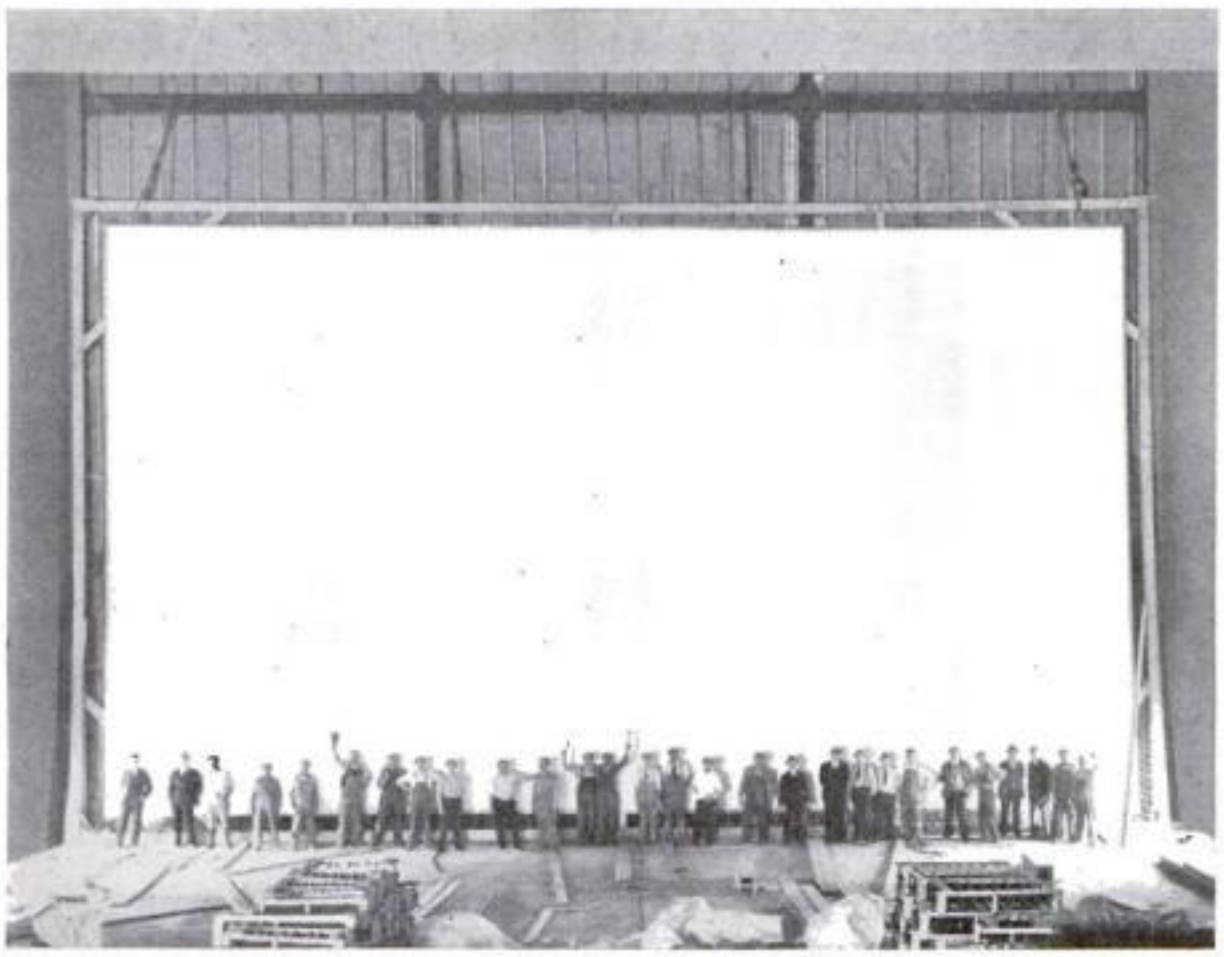
HALF airplane and half boat, an aquatic craft, recently patented by two Jacksonville, Fla., inventors, is designed to skim the water at express-train speed. A stepped hull like that of a hydroplane lifts the boat virtually out of the water, and the pilot steers it with an air rudder mounted on an airplane tail. A pontoon supports the tail when the craft is at rest or traveling at slow speed. To lessen the drag produced by the vacuum that normally forms behind the step of a hydroplane, the inventors have incorporated an innovation in their design. Two inlets are provided above the waterline, one at each side of the prow, through which air passes into tubes and emerges just behind the step. This conteracts the vacuum and adds to the boat's speed. Power to drive the odd speedboat is supplied by an outboard motor hung in a well amidships, just behind the pilot. However, the inventors say that their design is adaptable to the use of an inboard motor, and they also plan experiments with the possibility of rocket propulsion for his craft.



Front and side views of the new airplanelike speedboat. At top, how craft looks when speeding over water

MOVIES ON WORLD'S BIGGEST SCREEN

TALKIE films, projected by a new process on what is believed to be the largest screen in the world, are said to possess new qualities of realism. The screen measures sixty-four feet in width and thirty-eight feet in height, and its enormous size may be gaged by comparison with the figures in the photograph below. Its special construction gives an illusion of depth or three-dimensional quality to the pictures. The system has an improved method of sound recording.



Talking movies are thrown on this screen which is 64 feet wide and 38 feet high. Believed to be the largest in the world, its construction gives a suggestion of depth to pictures

STAINLESS DESK BLOTTER CONTAINS SOME RUBBER

A NEW composition desk blotter recently invented is said to have all the advantages of the ordinary paper blotter and none of its disadvantages. Made from a special formula containing rubber, it is indestructible and easily cleaned with a damp cloth. It will not stain, and lighted cigarettes or heavy objects will not mar its finish. Grooves and cups molded into the desk pad hold pens.

MODEL MAKER FINISHES HIS 116TH VESSEL

A THIRTY-INCH reproduction of the Flying Cloud, famous clipper ship of Colonial times, recently brought the number of ship models constructed by Herbert M. Skinner, seventy-nine, retired Fall River, Mass., teacher to 116. His latest miniature vessel required 157 hours to build. He presented it to the B.M.C. Durfee High School, where he taught.

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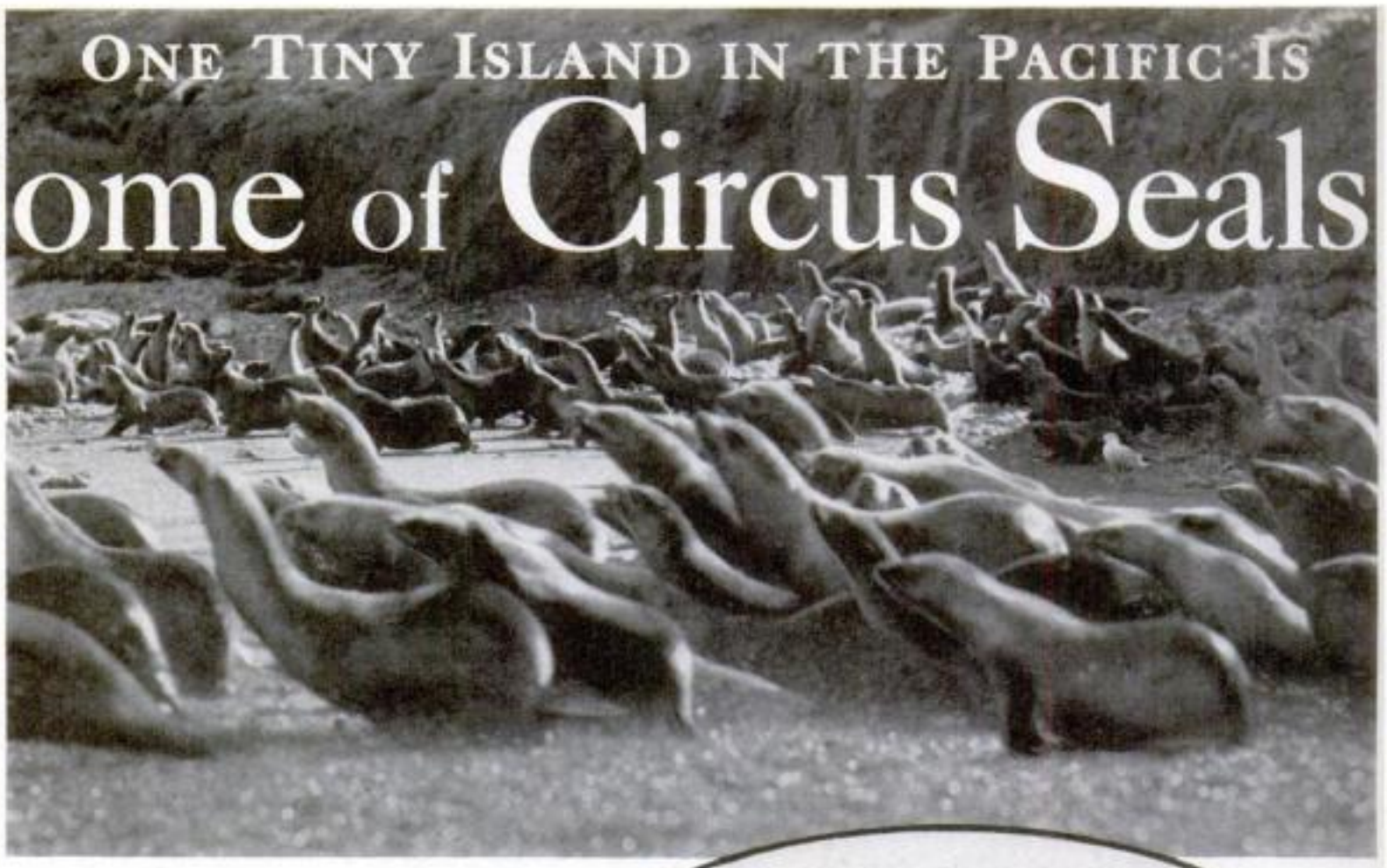
ONE TINY ISLAND IN THE PACIFIC IS

Home of Circus Seals



On this tiny island, twenty miles off the California coast, all of the sea lions seen in zoo, circus, or on the stage are captured by two men. Photo shows the isle covered with lions

In this net, sea lions are caught as they try to escape from a cave on Coronado Island to the Pacific. When the net is hauled in, the lions go into the hold of the boat seen above

TWO Portuguese fishermen, father and son, capture on the middle Coronado island, off the coast of Lower California, all the trained "seals" that are seen on stage, in circus, or zoo. With their bare hands and a net no longer than a city block, aided by rifle shots to frighten the animals, Steve and John Zolezzi have taken nearly 1,200 of the sea lions, which is what the so called seals of the circus actually are.

The Zolezzis put out from San Diego in their little fishing boat for the islands, which are twenty miles distant. Once on the rocky shore of the mid-island, they wait for high tide. At that time, the lions retreat within a long cave, cut off from the sea during low tide.

The men give the sea lions a sporting chance, however, for they effect their capture only at full tide. When ready, an assistant fires a rifle near the mouth of the cave. As many as a hundred sea lions rush for the open Pacific. Two or three become entangled in the meshes of the net which, meantime, has been slung across the inlet.

Steve Zolezzi then unties one end of the net from a jutting rock, carries it in a semi-circle to the other rocky wall, thus closing the captives within its frail strands. Quickly, lest the sea lions chew their way out, he rows out to his boat where they are hoisted aboard and dropped into the copper-lined hold. Later the animals are trained for formal appearances before delighted crowds who see them at the zoo or in circuses.

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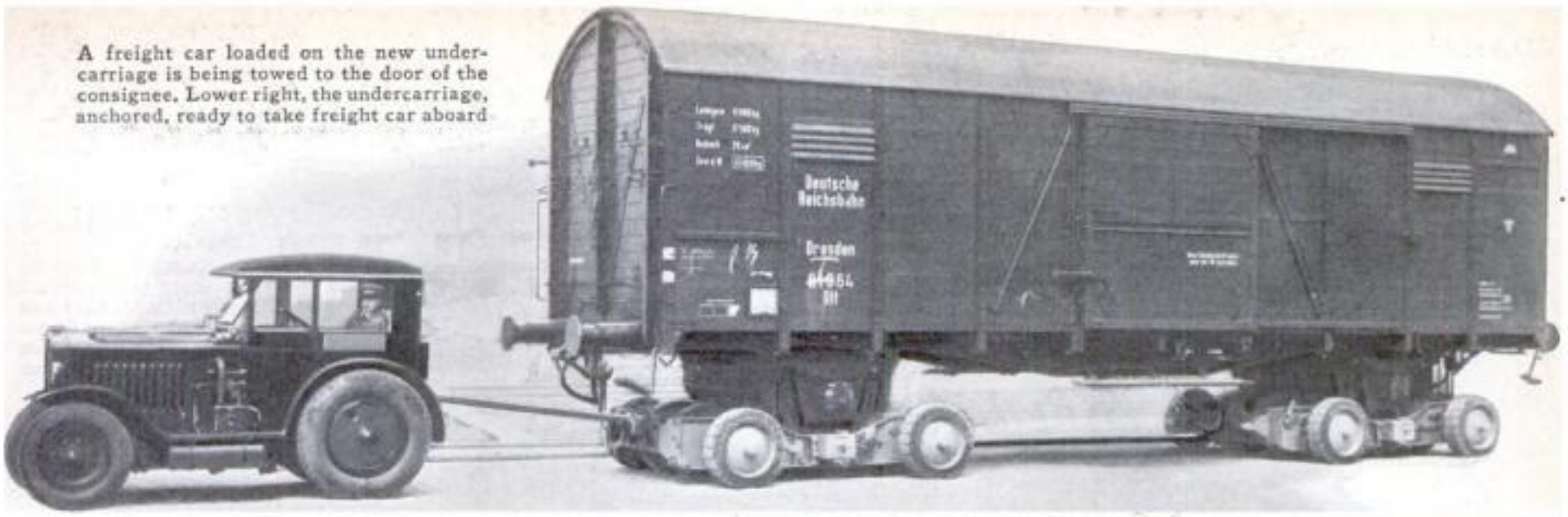
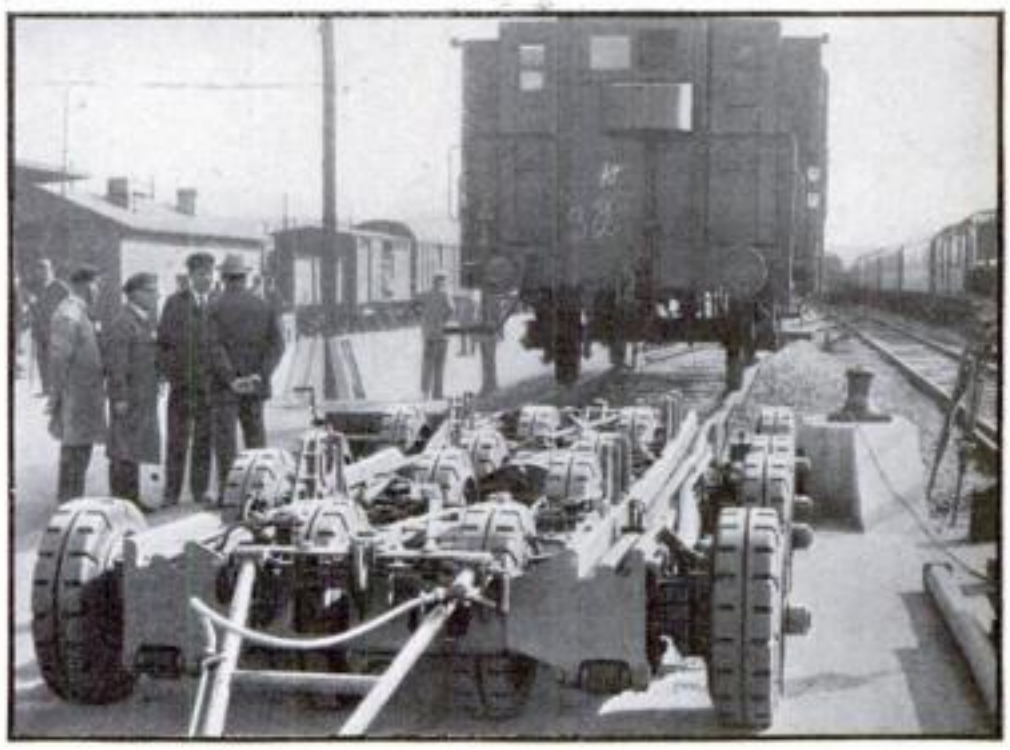


A freight car loaded on the new undercarriage is being towed to the door of the consignee. Lower right, the undercarriage, anchored, ready to take freight car aboard

FREIGHT CAR BRINGS GOODS RIGHT TO YOUR DOOR

A FREIGHT car loaded with merchandise may be carried bodily through the streets and delivered at the consignee's door, with the aid of an ingenious undercarriage devised by a German inventor. The invention is expected to prove a boon to factory owners without railroad sidings of their own for loading and unloading goods. It operates as follows: First the undercarriage is backed against the end of a siding where a freight car is waiting, as shown in the picture at the right, and is anchored to the track. The freight car is then rolled upon it, one truck at a time. As the second truck comes aboard, the telescopic undercarriage automatically lengthens to the form shown in the upper photograph. A powerful tractor then tows it to its destination. Sixteen wheels distribute the load evenly to avoid damage to the pavement.



BLACK LIGHT REVEALS BAD RYEGRASS SEED

INFERIOR ryegrass seed can be detected quickly by a method worked out by U. S. Department of Agriculture experts. The seed, first germinated on white filter paper, is placed beneath the rays of an ultra-violet lamp, as illustrated in the photograph above. If the seeds are of the preferred variety, nothing happens. If they are lower quality seeds, the paper in the darkness gives off a fluorescent glow. An ordinary electric bulb, fitted with a special screen, will serve for the test.

130 DENTAL DRILLS BUZZ IN ONE ROOM

IF THE sound of a dentist's drill gives you a slightly weak sensation, imagine a hundred and thirty of them going at once! This is the number of dental chairs, complete with every modern piece of equipment, that line the monster hall at the University of Pennsylvania where students of dentistry learn their profession. Since the embryo dentists have already acquired a high degree of skill before being allowed to treat actual cases, volunteer patients are not hard to find.

Dental students at the University of Pennsylvania demonstrate their skill upon 130 patients who flocked into one laboratory to receive treatment at their hands

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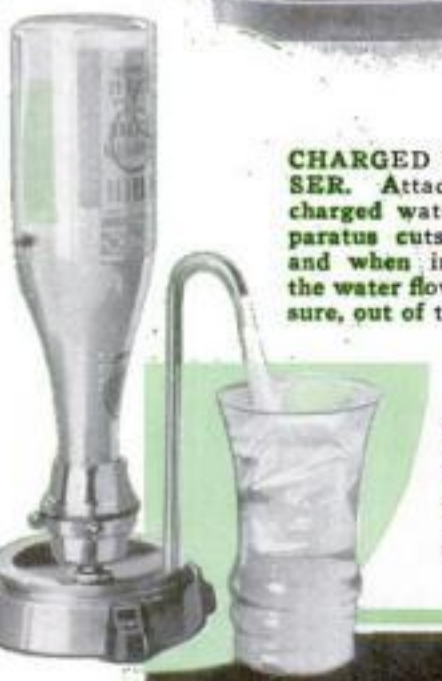
Novel Appliances

COFFEE CAN'T BOIL. There is no danger of spoiling the coffee by boiling it with the new percolator, two views of which are shown at left and below. At 190 degrees, an automatic pump closes a valve so that the water is shut off from coffee which cannot become too strong

ICE CREAM OUTFIT. Below, on the right, is a breaker that reduces ice cubes to chips so that, when mixed with salt, they can be used in the freezer shown to make ice cream at home

KEEPS FOOD WARM. When dinner is delayed, food is kept warm in the utensil shown here. The center compartment, filled with hot water, heats the contents of the outer sections

FLOUR SIFTER ON PACKAGE. Securely placed in the end of a box of flour, this metal device sifts the flour as it is poured, thus combining two ordinary operations in one



CHARGED WATER DISPENSER. Attached to a bottle of charged water, this simple apparatus cuts a hole in the top and when inverted, as shown, the water flows, by its own pressure, out of the tube into a glass

SAVES THE GAS. A hot water tank can be insulated in a few minutes with the two-piece jacket that is seen below

LOVE SEAT ALSO A BED By pressure on a lever, this love seat is easily turned into a comfortable bed as may be seen in the lower photo. The ends drop down and the cushions build up ends of mattress

Copyrighted material

for the HOUSEHOLD

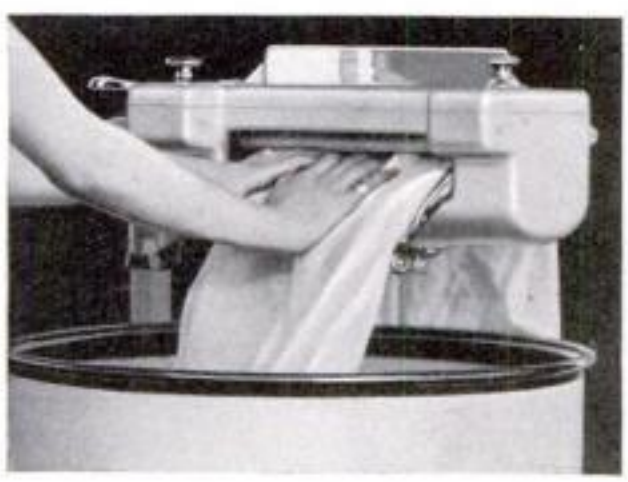
RUGS MADE ON SEWING MACHINE. A knife-like blade, with a long slot in it, makes it possible to create heavy rugs on your sewing machine. Yarn is wound around the blade which is then placed under machine's presser foot and stitched, as shown in photo at lower left. By repeating the operation, a rug like the one shown results when these strips of material are all sewed together

HOLDER FOR SPOONS. This little device, which slips readily over the edge of any cooking utensil, prevents the stirring spoon from falling into vessel

HEADLIGHT ON CLEANER. This new vacuum cleaner carries a powerful electric lamp so light is thrown under furniture and into dark corners. Current is supplied by the same cord that runs the cleaner but a separate switch controls light so it can be turned on at will

SILENT ELECTRIC FAN. Wide, overlapping blades, that uniformly and silently move the air, take the buzz out of this electric fan without reducing its efficiency

HIGH CLOTHES HANGER. By means of a hook that slides up and down in a metal groove, clothes may be hung at top of a closet, thus increasing its capacity



WRINGER CAN'T GRAB FINGERS. Radically new in design, this clothes wringer has four rollers. It also has an automatic release that separates rolls and stops them instantly if one's hands are caught

PICTURES HUNG WITHOUT WIRES. This two-piece metal picture hanger makes it possible to hang pictures without hooks or wires. One piece fastens to the back of the picture and the other to the wall. When fitted together, they will support the picture

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THERMIT WELDING PROCESS. In your laboratory, this experiment is carried out by placing aluminum paint powder and magnetic iron oxide in a flower pot. Barium nitrate, aluminum powder, and sulphur are mixed as a starter. This is fired by holding lighted matches, in pliers, against it. Intense heat accompanies the process

PRACTICAL AND MYSTIFYING Home Tests YOU CAN MAKE WITH IRON

By Raymond B. Wailes

MYSTIFYING and spectacular effects give a keen interest to home experiments with iron and its compounds. The amateur chemist can make paint, produce molten iron from a simple mixture, and perform many other stunts that show why iron is man's most useful metal.

Iron betrays its presence everywhere. Our blood gets its red color from the iron it contains. Soils, clays, bricks, and stones are colored by the iron in the earth's crust.

A handful of ordinary nails or tacks will serve as the starting point for the home chemist's experiments. From them he can produce several interesting iron compounds.

Iron, as we know, is attacked or dissolved by acids. This can be demonstrated by placing several iron nails in a test tube of sulphuric acid. To speed up the reaction, warm the tube gently. Soon gas bubbles will be given off and close inspection will discover tiny black specks in the liquid. The gas is hydrogen and the black specks, when filtered out, will prove to be small bits of carbon. Carbon is present in most forms of iron as an impurity. Cast iron, which contains more carbon, will produce more black specks than the wire nails.

As the reaction continues, you may notice a peculiar odor. This is caused by the escaping gas which not only contains odorless hydrogen but acetylene or other hydrocarbon gases as well. The carbon, chemically combined with the iron, reacts to form a carbide which, in the presence of water or a dilute acid, forms acetylene gas easily recognized by its characteristic odor.

When the tiny specks of carbon have been filtered from the solution, the remaining liquid will be a beautiful green. This filtrate is iron (ferrous) sulphate, sometimes called "copperas." This is an unfortunate name, however, for contrary to its spelling and sound, copperas contains no copper.

If this solution is allowed to evaporate, an interesting mass of green crystals will be formed. However, being particularly efflorescent (drying out rapidly) they will soon crumble to a white powder due to their water of crystallization. To preserve them for future use, place them in a tightly stoppered bottle. Study the crystals closely; they play an important part in the manufacture of paints, inks, and dyes.

PLACE a few of the green crystals of iron sulphate in a porcelain crucible or evaporating dish and heat them. Sulphur dioxide and sulphur trioxide will be driven off as they decompose, leaving a soft reddish-brown powder of iron oxide that is particularly valuable as a polishing material, known as jeweler's rouge, and as a pigment in the manufacture of red paint. To demonstrate its usefulness as a paint pigment, mix the powder with some linseed oil, thin it with turpentine, and add a drop or two of drier. In preparing the iron oxide be sure to continue the heating of the crystals until all the fumes have been driven off. During this process, stir it continuously to expose all the material.

If, instead of dissolving the iron nails or tacks in sulphuric acid, hydrochloric acid is used, iron chloride will be formed. Crystals of iron chloride contain so much water of crystallization that they often conglomerate into one solid mass. Placed in a beaker and heated without water, they will melt in their own water of crystallization.

When in this fluid state, the substance has a remarkable property. It will dissolve a long strip of thin paper, making it disappear as it is fed into the liquid. The amateur chemist can amuse his friends by preparing a small quantity of the liquid iron chloride and feeding two or three feet of tissue paper into the beaker. Bit by bit, the long strip will be consumed. Then if the solution is poured into a large quantity of water, the paper will reappear as small hairlike particles.

Paint for Labels

Inexpensive and permanent labels can be applied to your laboratory bottles by making up a mixture of zinc oxide in clear varnish. The lettering, drawn in with a small brush, will be waterproof.

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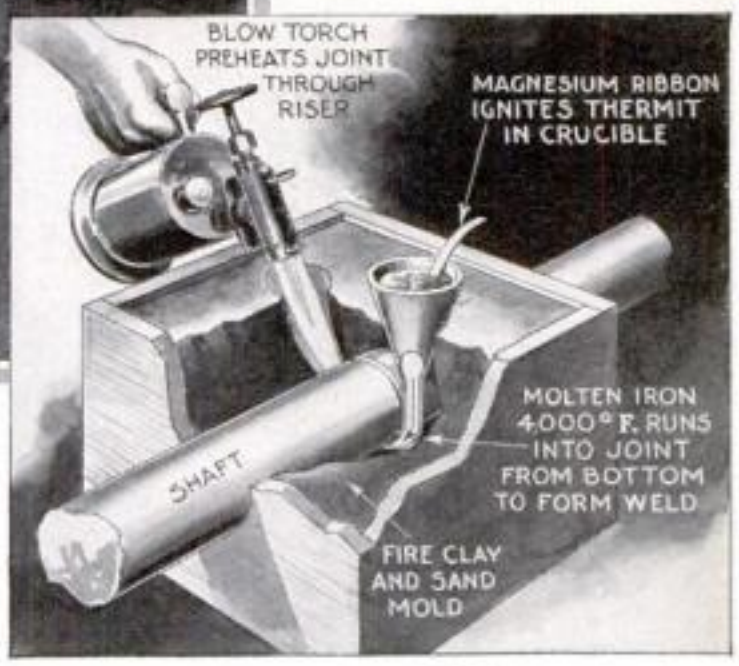
Experiments Show How Ore Is Reduced— An Amazing Welding Process Is Duplicated in Your Own Laboratory

HOMEMADE PAINT. From crystals of iron sulphate a reddish powder is obtained. Mixed with oil and turpentine, it makes a good paint for your equipment

TWO CLEVER TRICKS FOR THE AMATEUR CHEMIST

Words written with a nail on a piece of chemically treated iron, as in circle, will be visible when iron is dipped in copper sulphate. Melted crystals of iron chloride will eat up several feet of tissue paper fed into them, as is shown in the picture above



INDUSTRIAL WELDING PROCESS. Drawing shows manner in which thermit welding is done in big factories. Magnesium ignites iron oxide and aluminum which then react to produce heat and reduce iron to a molten mass

Small iron objects can be coated with copper in the home laboratory merely by immersing them in a solution of copper sulphate. The iron is said to be plated by immersion to distinguish it from the coating obtained by electroplating. Unfortunately, the coating is extremely thin and soon disappears.

NOT every iron surface will exhibit this property, however. Armed with a few simple chemicals, the amateur can treat the surface of a piece of iron to prevent the formation of the copper coating.

First, clean the strip of iron thoroughly with sandpaper and immerse it in nitric acid until the evolution of reddish-brown gases indicate that the iron is being attacked. Then remove the iron, wash it in water, dip it in a solution of potassium dichromate, and wash it again. The iron then is in a passive state, the treatment tending to alter the surface iron. If the strip is immersed in the solution of copper sulphate, no coating of copper will be deposited on its surface. As only the surface of the iron is changed, however, it can be brought back to normal by striking it a blow or scratching it with a sharp pointed instrument. The blow or the scratching breaks the passive skin effect and again causes the copper to be deposited where the skin has been broken.

This peculiar quality makes it possible for the amateur chemist to perform a surprising experiment. Treat the surface of a strip of iron as described so it is in the passive state. Then, using the sharp point of a nail, write your name on the surface of the strip. The passive skin effect will be broken where the point of the nail touches the surface and, by immersing the strip in copper sulphate, the words will be made visible by the line of copper deposited.

The use of chromates and dichromates to protect the surface of iron from rust and corrosion is put to practical use. Another method of protecting iron, somewhat similar to the method of obtaining surface passivity, is called "parkerizing." It consists in causing the surface of the iron to become coated with a thin layer of phosphate of iron. One simple way of doing this is to heat, in a solution of phosphoric acid, the iron that is to be corrosion-proofed. The home chemist can parkerize in a small way by dipping the iron into the ordinary phosphate solution used at soda fountains.

SINCE iron combines readily with oxygen to form iron oxide, it would seem logical to suppose that iron oxide could be reduced to form iron. This is true. In fact, this is what is done when iron is obtained originally from the iron ore. Iron oxide (iron ore) is heated in a large blast furnace with carbon in the form of coke. The carbon combines with the oxygen in the iron oxide, leaving pure iron. A process of this type is called reduction; the iron oxide being reduced to iron.

ALTHOUGH this particular process would be too bulky to duplicate in the home laboratory, the amateur can simulate the reduction of iron oxide by using easily obtained hydrogen gas in place of the carbon. Place the iron oxide, which you obtained by heating the iron sulphate, in a non-metallic tube. Heat the tube and pass hydrogen gas through it. The hydrogen will combine with the oxygen and reduce the iron oxide to iron. If your attempt has been successful, a magnet will attract the small particles of iron formed.

The fact that aluminum also exhibits the property of reducing iron oxide to iron forms the basis of a very interesting and useful industrial process. In factories and repair shops, this simple chemical reaction is known as the "thermit" process of iron welding. Iron oxide is mixed with aluminum and ignited. This causes the two chemicals to react and give off a great amount of heat. In fact, so great is the temperature that the iron, freed by the reaction, flows *(Continued on page 85)*

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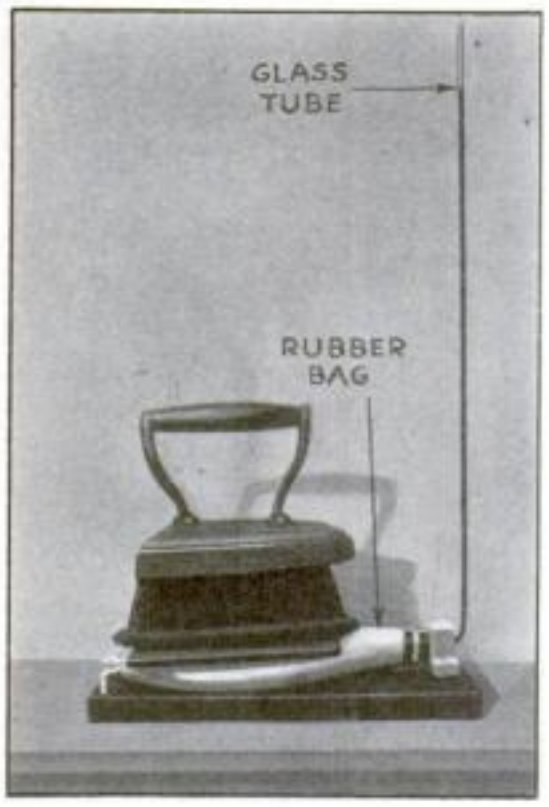
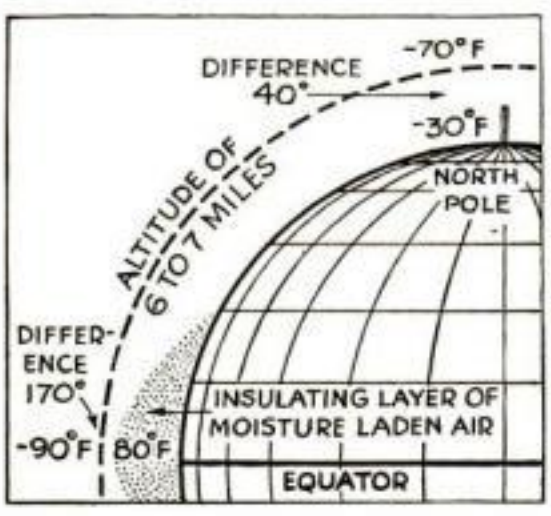
NATURAL LAWS

That Work in a Mysterious Way



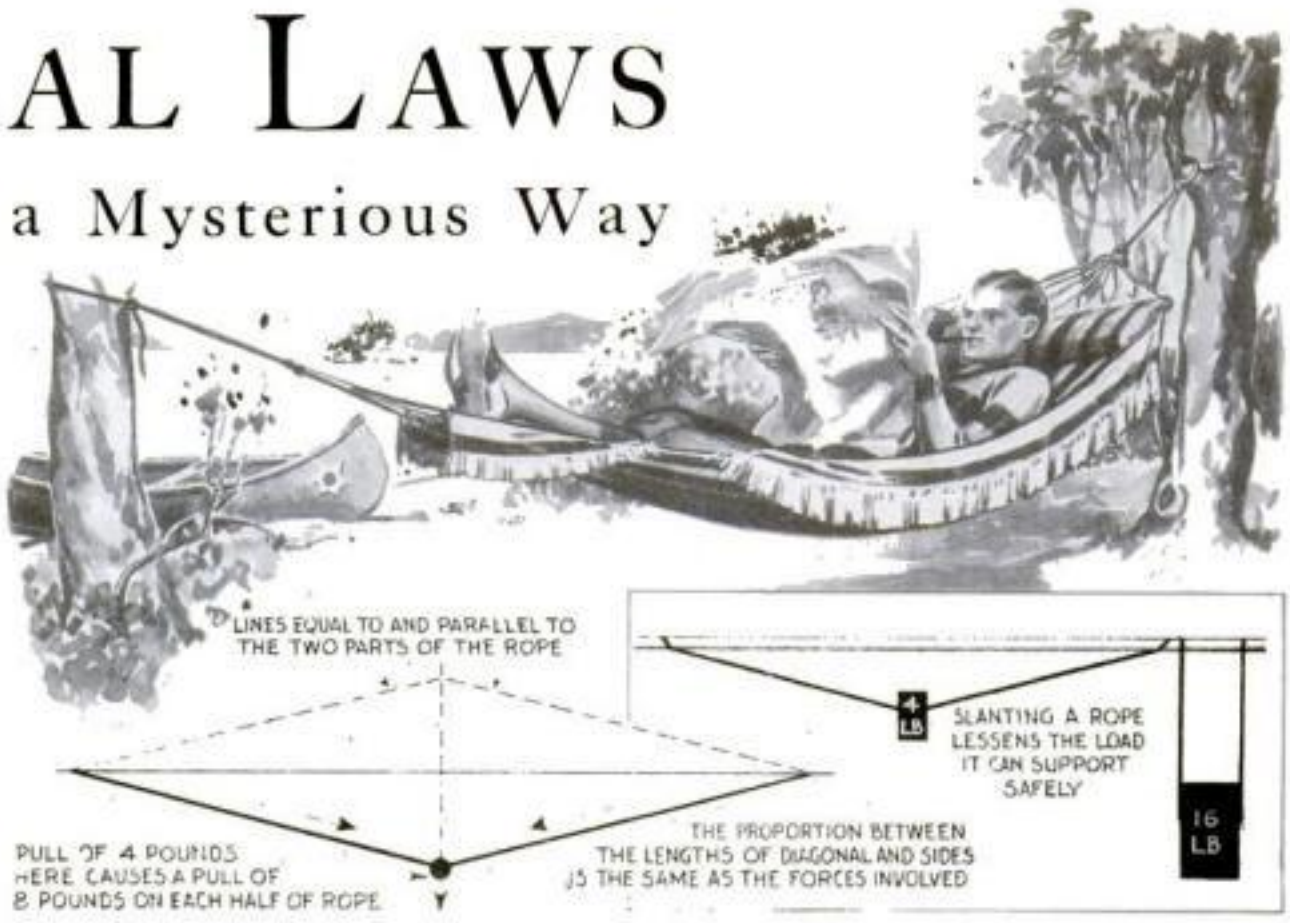
When Water Will Support Many Times Its Weight

APPARENT paradoxes may result from the workings of natural laws, as pictures on this page show. In the photograph above, the column of colored water in the tube is supporting many times its own weight. How? The answer is that the water column's total weight is transmitted undiminished to every area of the bag's surface that equals the tube's cross section. Thus, the total pressure is sufficient to support the weight.



Colder Over the Equator Than It Is Above the Pole

FEW would credit the statement that it is colder at the equator than at the north pole. At very high altitudes, however, this is true, as sounding balloons sent up six or seven miles show. At that height, the temperature of the air above the tropics is twenty degrees colder than at a similar elevation over the Arctic. One suggested explanation is that humid air retards re-radiation of heat from the earth.

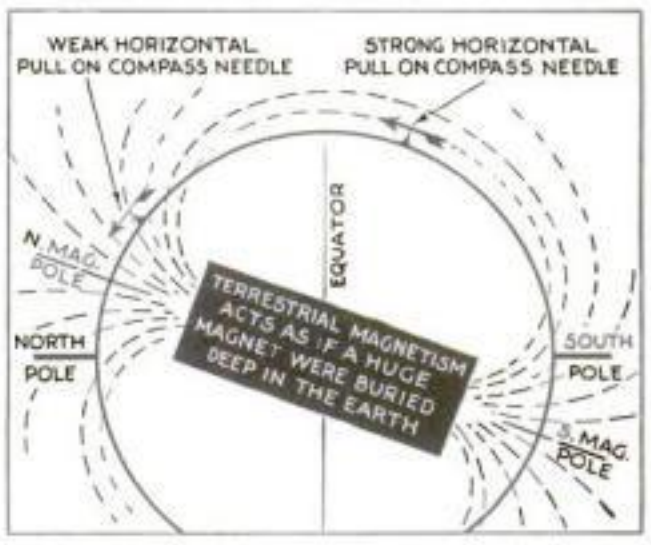


Why Hammock Ropes Break Easily Under Light Load

IS A ROPE'S strength always the same? Vertical cords in the right-hand diagram above can support a sixteen-pound weight; slant them as in the companion view, and they will hold only four pounds. This explains why hammocks are so easily broken down. The mechanics of the phenomenon is made clear if you consider that the ropes pull upward to offset the downward tug of the weight. Slanted ropes must pull harder because of their less effective angle, and the strain becomes enormous when they are nearly horizontal, as an engineer will demonstrate with the method shown.

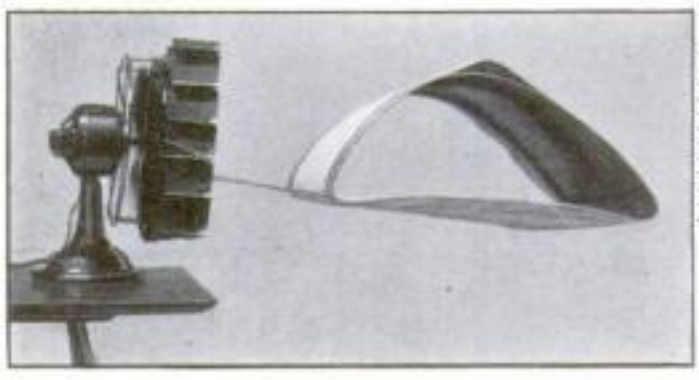
Pull On Compass Weakest In Region Near North Pole

A COMPASS needle swings northward in response to the attraction of the earth's magnetic pole, but the nearer it approaches the pole, the weaker the pull becomes. This phenomenon, which makes the compass unreliable in the arctic, occurs because the needle seeks a point that is far beneath the earth's surface. Therefore the horizontal force on the needle diminishes as the magnetic pole is approached. Dotted lines, in the diagram at the right, show the real direction of the pull on a compass needle at any point on the earth's surface. Note also that the north and south magnetic poles do not coincide with the geographical poles though they are near those points.



How Hump In Wing Gives Airplane Lifting Power

LOOKING at the wings of a big plane, an observer will see that the top side is arched while the bottom is nearly flat. The shape looks wrong; it seems as if air, striking the hump, should force the craft down. Actually the hump gives the plane most of its lifting power. By deflecting the air stream, it produces an upward suction on the wing, as the diagram shows. This effect may be demonstrated with the apparatus in the photograph, using an egg-crate grille to steady the breeze from an electric fan. A frame shaped like an airplane wing is attached so it flies freely. When a sheet of paper is draped loosely over it, the top of the loose paper rises in an arch strongly suggestive of the hump that has been found essential to the airplane wing.



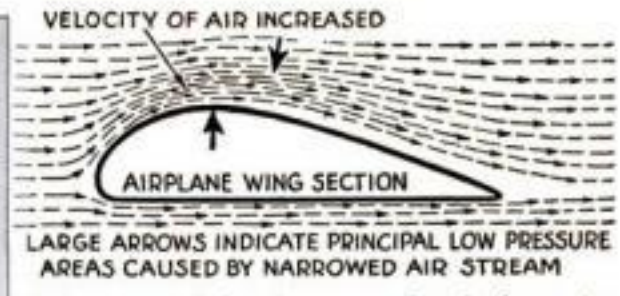


Diagram explains the reason for the hump in the wing of an airplane. Left, simple apparatus used to demonstrate the effect of this hump

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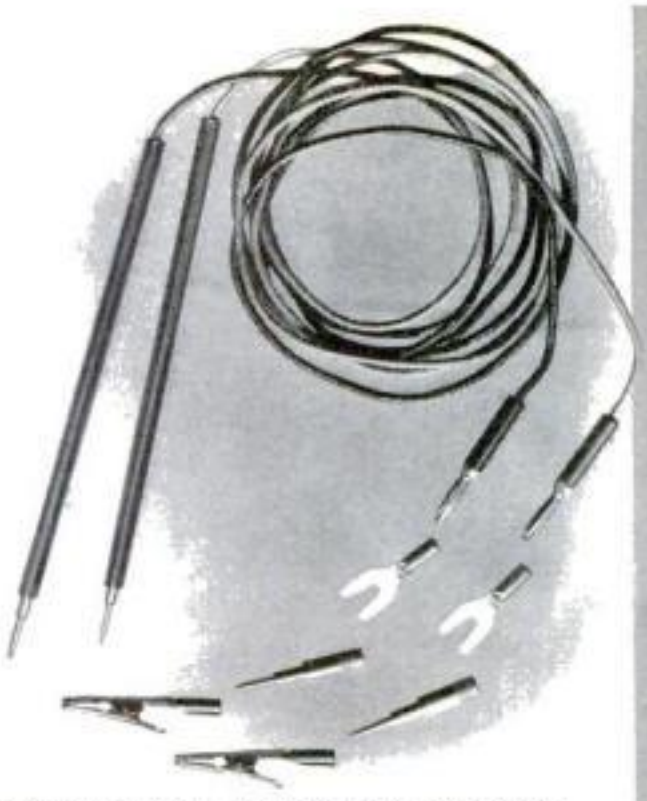
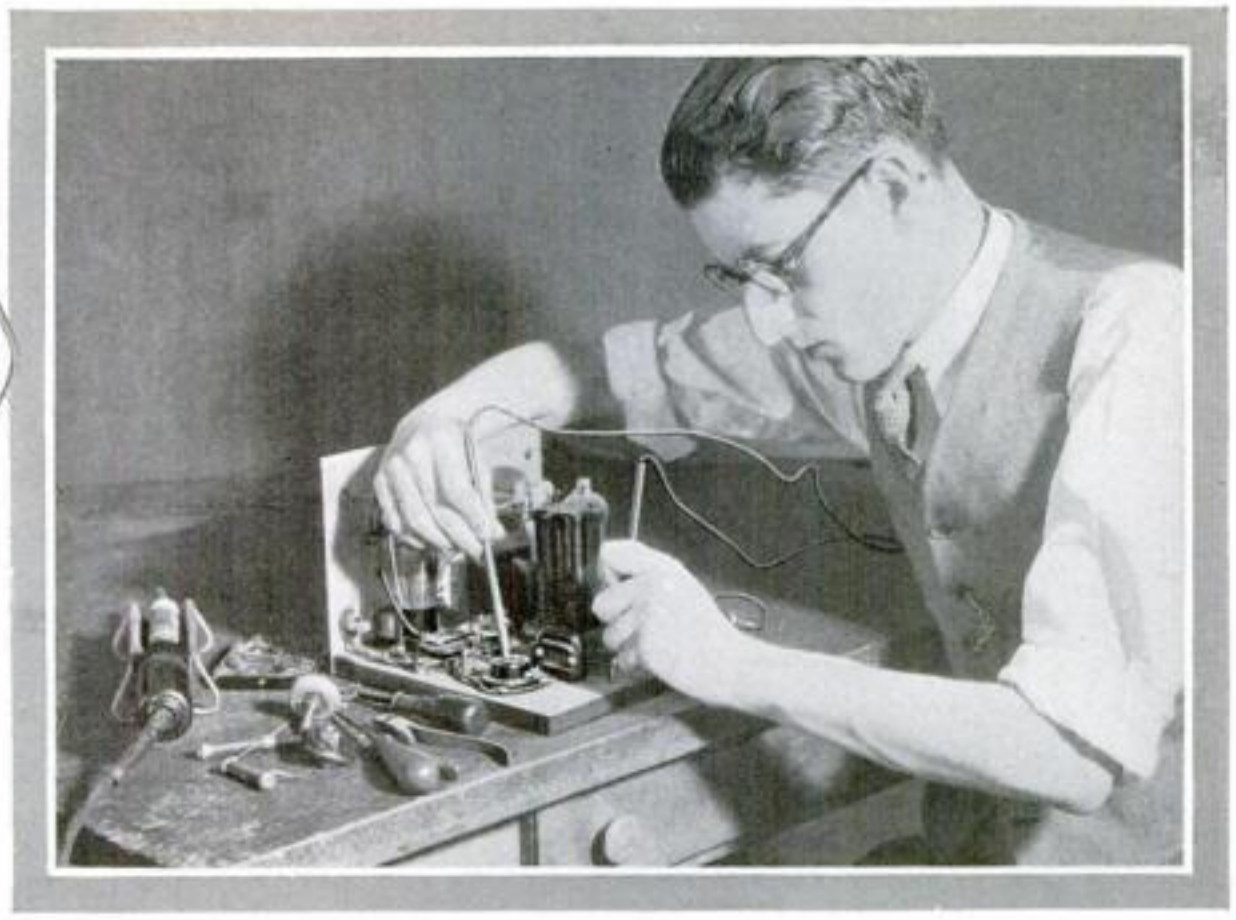


These test prods, with insulated, slender handles, are equipped with a new type of needle-point phone tip. Used as shown at the right, they simplify the problem of making tests



Test Prods Aid Radio Builder

WHEN repairing or building radios, the problem of making good test connections is simplified by the ingenious test prods shown in the illustration at upper right. Besides having long, insulated handles, slender enough to slip easily into the crammed depths of a set, these prods are equipped with a new type of needle-point phone tip. The sharp points will pierce insulation and corrosion and are designed to fit all standard phone-tip jacks. The outer ends of the insulated lead wires terminate in convenient spring prongs allowing spade lugs, needle-point phone tips, or alligator spring clips to be slipped on quickly as desired. Every type of terminal is always handy for use.

Oiled Clothesline Good for Antenna Halyards

RIGGING a high receiving or transmitting antenna on poles or towers always presents the perplexing problem of what to use for the antenna halyards and guys. The amateur can make extremely strong rope, that will wear almost as well as metal cable and yet have the advantage of being soft, pliable, and inexpensive, by thoroughly soaking ordinary heavy braided clothesline in boiled linseed oil. Besides strengthening the rope, the oil will prevent the fibers from shrinking and thus placing undue stress on the antenna.

Tubes Are Described by New Number System

UNLIKE the old system of numbering radio tubes, the new type numbers tell a definite story. Tube labels now describe the features and specifications of the new tubes instead of merely serving to identify them.

Every digit and letter in the new tube numbering system means something. The first one or two digits, for instance, specify the filament voltage of the tube. Voltages below 2.1 are identified by the digit 1. For filament voltages between 2.1 and 2.9, the figure 2 is used and the figure 3 denotes a voltage between 3 and 3.9. Thus the number of a tube of the 2-volt variety will begin with the figure 1, a 2.5-volt tube with the number 2, and so on.

Following the first set of digits in each case is a letter. This is the serial identification. Rectifiers start with the letter Z and go back through the alphabet; other tubes begin with A and go down the alphabet. The number directly following the serial letter indicates the number of useful elements in the tube.

With this system we know that the 2A5 is a 2.5-volt tube having five useful elements and the 25Z5 is a rectifier having a 25-volt filament and five elements.

Right Position of Power Plug Improves Set

BY REVERSING the power plug on your A. C. receiver, you may find that the quality of reception is improved. Strangely enough, even though the polarity in an A. C. circuit runs both ways, there is a right and a wrong way to insert the plug. The current will run through your receiver one way better than the other and the trick of reversing the plug is to find the better way.

Test your receiver by reversing the plug several times. Then, when you have found the position that works best, file a small groove in the edge of the composition plug and another under it in the face of the socket. To make the marks permanent, drop a bit of white enamel into each of the grooves. These reference marks will make it a simple matter to replace the plug at any time in the one position that gives the best results.

Since correct polarity is of even greater importance with direct current, the same system of marking can be applied to the power plugs of D. C. operated sets. If desired, temporary reference marks can be made with chalk.

In alternating current receivers, reception is sometimes improved by reversing the power plugs. After repeated tests, mark position for best results as shown above

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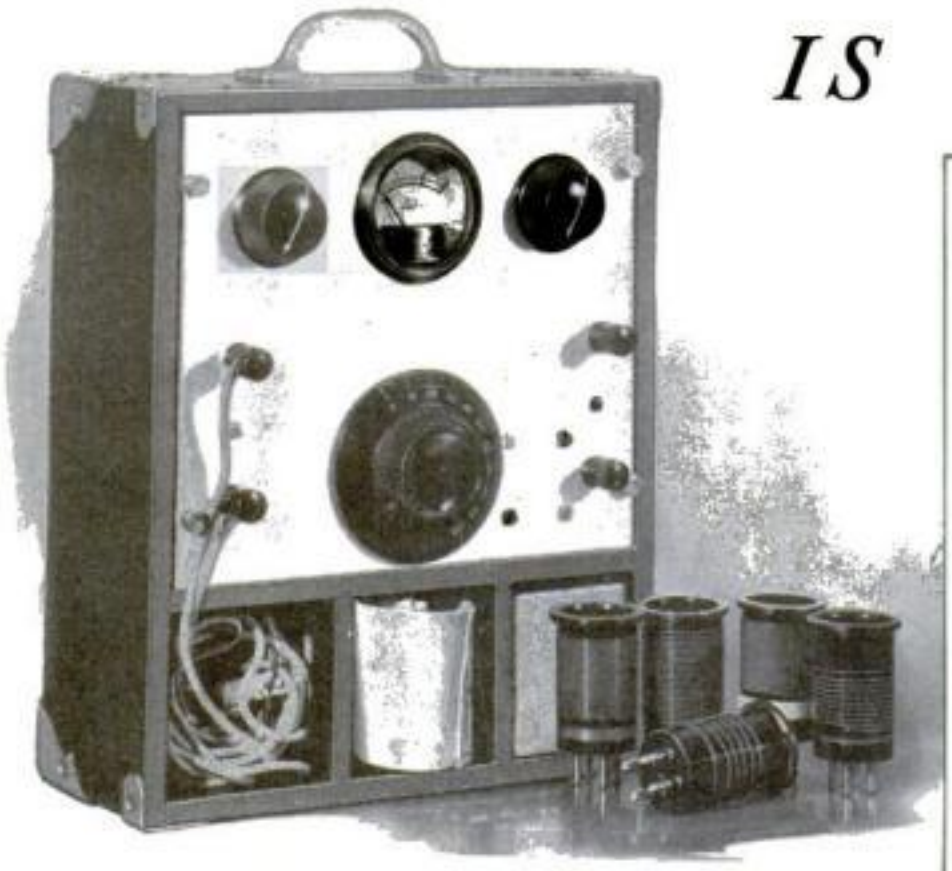
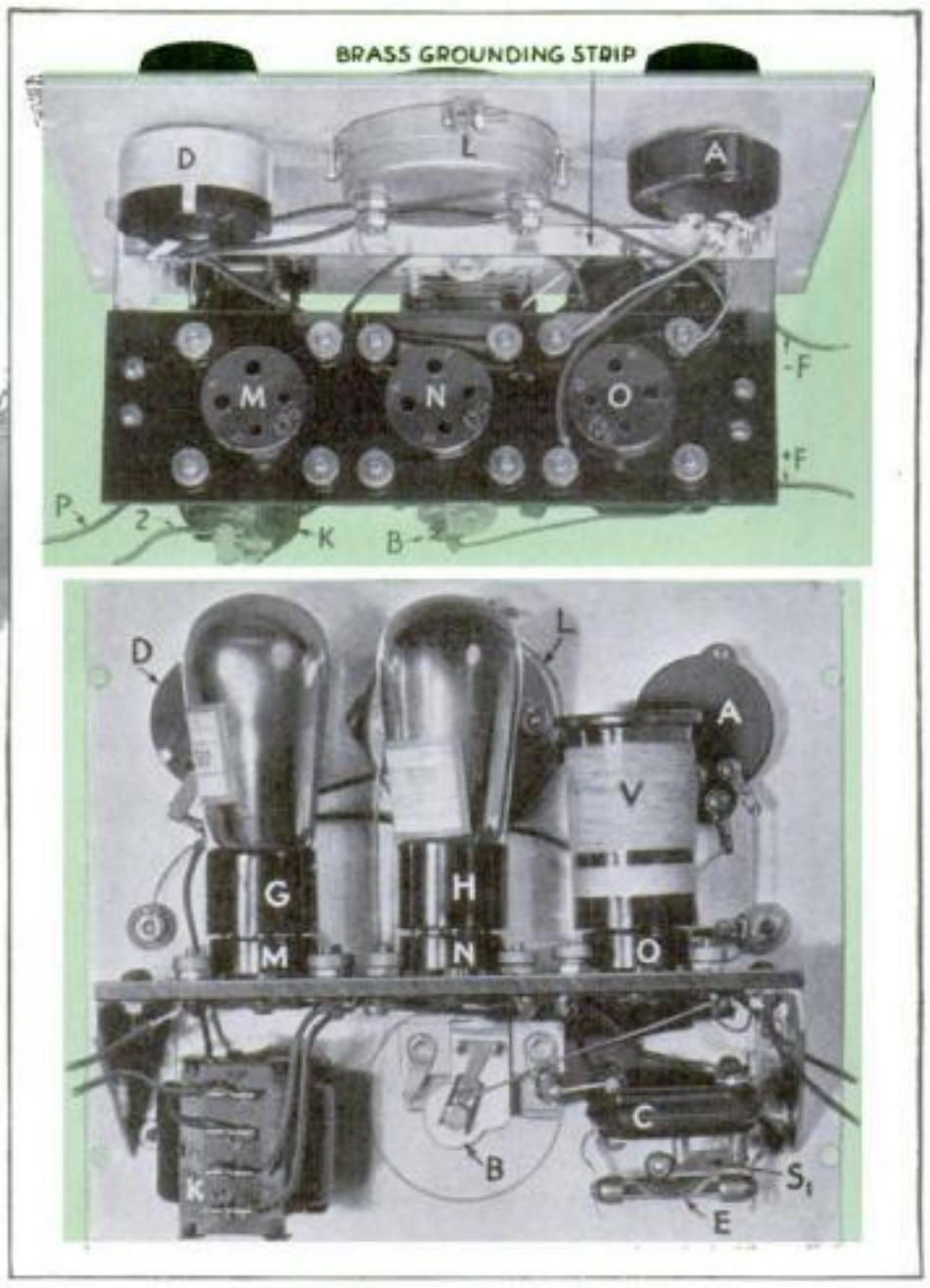
Flyweight Portable

IS EASILY BUILT



By Lt. William H. Wenstrom

Signal Corps, U. S. Army



Top view of portable radio set, upper right, shows three sockets, rheostat, tickler resistance, and voltmeter. At right, plan view of front panel as it is seen from rear. Above is the assembled set ready for use

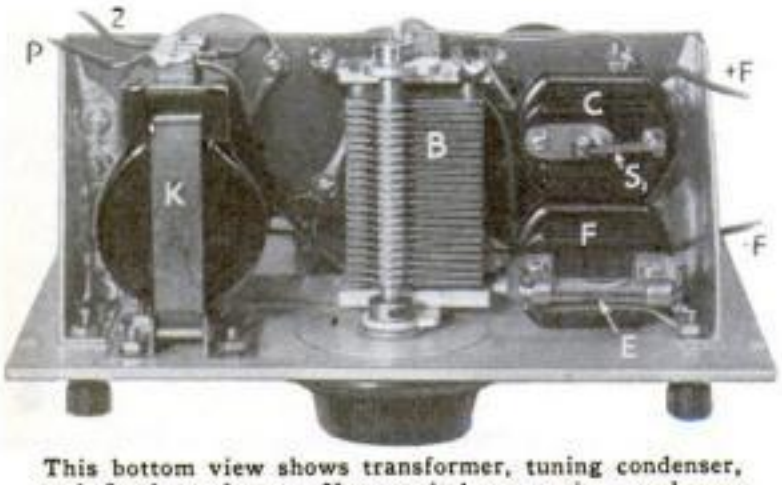
WHAT is happening in the world while you enjoy the quiet of your camp in the woods? Is your cruising sloop in for a hard blow? Will rain spoil that hike planned for tomorrow? Radio holds the answers to all these questions and the inexpensive portable receiver illustrated will bring them to you, in your boat, your summer camp, or your car.

Weighing less than ten pounds complete, this vacation companion covers all wave lengths from 15 to 1,500 meters. With it you can tune-in the short-wave transmitters and the long-wave weather stations as well as the regular broadcasting chains.

No set of its kind can be bought but it cost less than fifteen dollars to build. Its operating cost is negligible. A single ninety-cent B battery will last all summer and the two ordinary 1½-volt flashlight cell A batteries, obtainable anywhere for ten or fifteen cents, last for ten full hours of use.

Measuring 4 by 9 by 11 in. overall, the set, batteries, and earphones are complete in a single box that will fit in one end of an ordinary suitcase. No bulky antenna wire or heavy ground stake need be carried to take up extra room. The circuit operates on a 10-ft. antenna and a 10-ft. counterpoise that can be stored in the cabinet when they are not in use.

The circuit, embodying a carefully designed regenerative detector and one stage of audio amplification, is simplicity itself. Oscillation is smoothly controlled by a variable resistance (A) placed across the tickler and the tuning condenser (B) is made suitable for reception of either short or long waves by a fixed condenser (C), which can be shorted out, placed in series with it. With the shorting switch (S_1) open, the small condenser is in the circuit and the overall capacity is reduced for use with the short-wave coils. Seven plug-in coils in all are used to



This bottom view shows transformer, tuning condenser, and fixed condenser. Note switch on series condenser

LIST OF PARTS

A—Volume control, without switch, 50,000 ohms.
B—Midget variable condenser, 320 mmf.
C—Mica condenser with shorting switch (S_1), .00035 mfd.
D—Rheostat, midget, with insulating bushing, 10 ohms.
E—Grid leak, 5 megohms.
F—Mica condenser with grid leak clips, .00015 mfd.
G and *H*—Tubes, type '30.
J—Mica condenser, .006 mfd.
K—Small audio transformer.
L—Small voltmeter, 0-3 volts.
M, *N*, and *O*—Sockets, 4-prong.
Q, *R*, *S*, and *T*—4 short wave coils.
U and *V*—Broadcast coil set, 2 coils.
W—Long-wave coil (optional).
X—Earphones, high impedance.

Aluminum panel, ⅛ by 7 by 8 in.; composition subpanel, 3/16 by 2 by 7 in.; two aluminum sub-panel brackets (can be made); one 3-in. dial; two knobs; two insulated binding posts; two plain binding posts; wood for set box; clips; screws; nuts; connecting wire; solder; soft leather for portable earphone headband.

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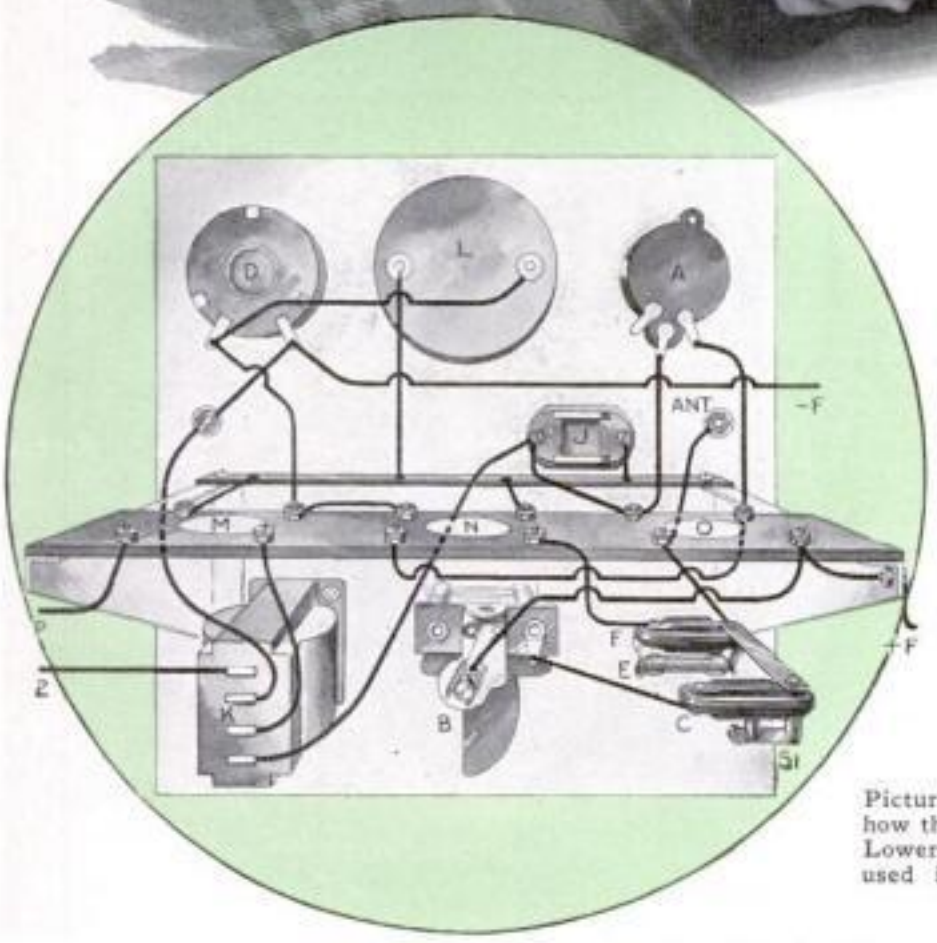
Radio Set

Blueprints Now Ready

HERE is your chance to build a lightweight, all-wave portable receiver, designed by a United States Army Signal Corps expert. With it you can tune in all waves from 15 to 1,500 meters on a 10 ft. antenna. To make the construction easier, send twenty-five cents for Popular Science Monthly Blueprint No. 217. It details all the parts, wiring, and cabinet and is accompanied by a list of the parts used by the author.



Picture diagram, left, shows how the portable set is wired. Lower left, diagram of circuit used in this easily built set

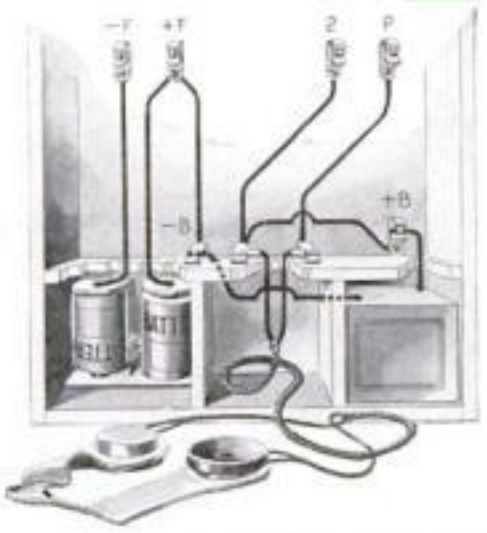
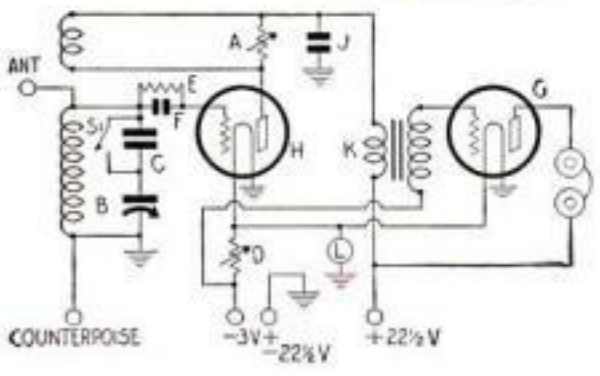


Diagram of lower half of receiver cabinet. Note how batteries are wired



cover the wave lengths from 15 to 1,500 meters.

The two tubes are 2-volt, .06-ampere type '30's. To save weight, only 22½ volts of B battery are used on both the detector and amplifier. Trial has found that this value works almost as well as 45 volts.

Using the 10-ft. antenna and counterpoise of ordinary lamp cord or similar wire, the set's daytime range is about 100 miles for the long waves and hundreds of miles for the short waves. These ranges, however, are much greater at night and are greatly increased when a larger antenna and a good ground are used.

In a one-hour test made in mid-afternoon with a 6-ft. antenna rigged 3 ft. above the ground and a 6-ft. counterpoise lying on the ground, over twenty-five stations were logged. The list included regular broadcasting, amateur, and commercial stations. Heading the short-wave list was station XDA, Mexico City, indicating a short-wave range of more than 1,000 miles. As to volume, two of the broadcasting stations came in with enough volume for faint "loudspeaker" reception.

If you have done any radio experimental work you probably have most of the equipment needed for the set on hand but before you use any parts, make sure that they check with the electrical specifications given in the box on the opposite page.

Although the four short-wave coils and the two broadcast coils can be made, I found that the complete set of six coils could be purchased already wound for little more than the commercial coil forms alone would cost. The price of the coil set is included in the total cost of fifteen dollars. The six coils should be of the type designed to operate with a .00014-mfd. variable condenser and should be arranged to fit a regular 4-prong tube socket.

The special long-wave coil for use in tuning in the long-wave weather stations must be made, however. This coil is developed from a commercial long-wave R. F. coil having a single winding of 10 pies on a 1¼-in. form, each pie, or section, being bank wound 4 turns deep and 10 to 12 turns wide. Such a coil can be bought from a large radio parts supply house for about seventy cents.

First, cut off the terminal end of the coil form, freeing the two ends of the winding. Then, counting up from the terminal end, space off two pies, or sections, and remove one half of the second pie, starting from its upper end. This will give you a tickler coil of about 1½ pies and a grid coil of 8 pies.

To mount the coil for plug-in use, remove the base from an old 4-prong tube and cut it off about ½ in. from the bottom. Ream out the inside of the base to receive the end of the coil form, slip the tickler end of the form in place, and bolt the form and the base together with two small machine screws. Then slip the four ends of the coil windings into the tube pins and solder them at the ends, connecting them to match the terminal connections on the regular coil set. In most cases this will be as *(Continued on page 93)*

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By

MARTIN BUNN

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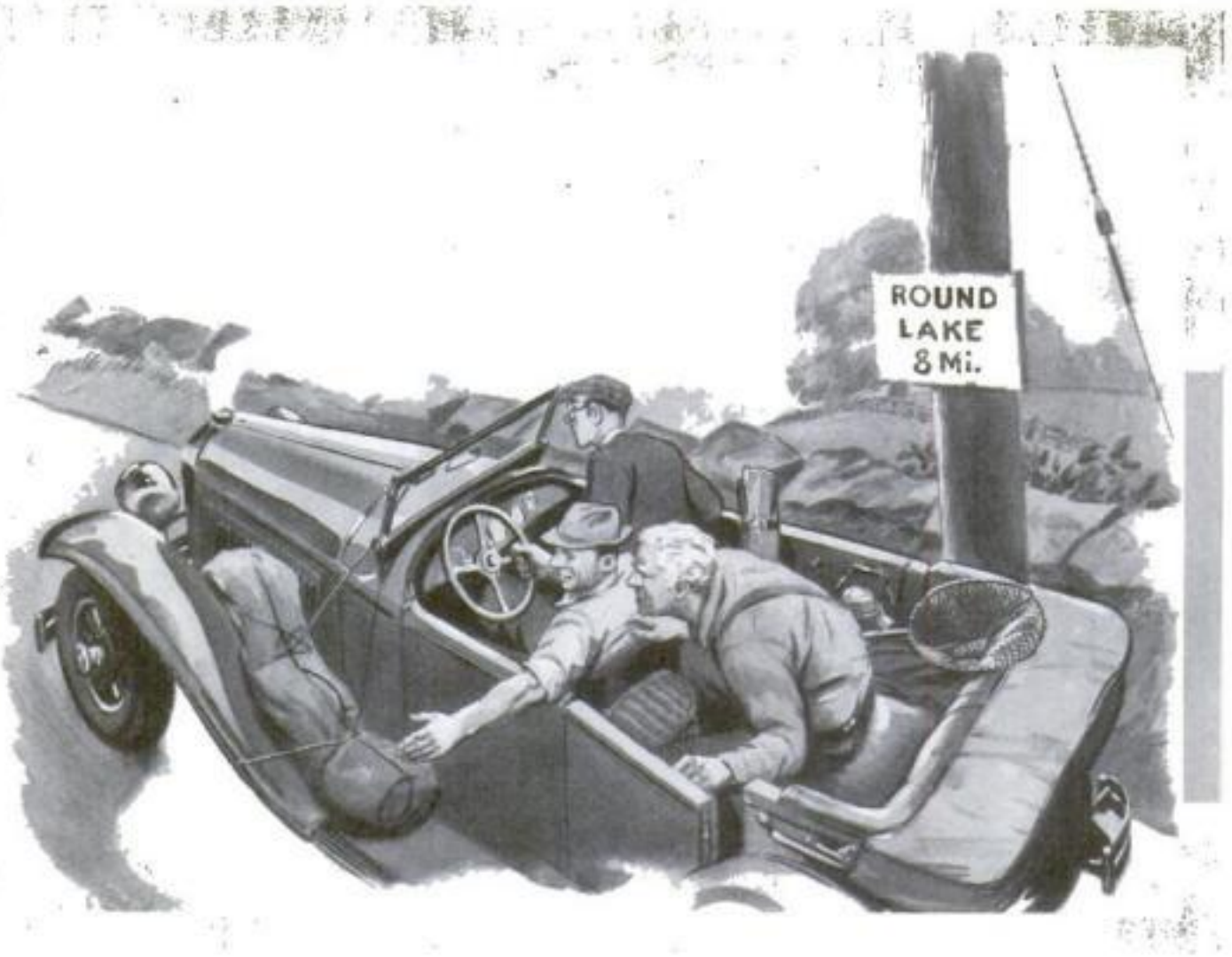

Ed Crowley's car was steaming like a teakettle. Odors of hot oil and scorched paint came over the windshield. "Looks like a sailor's holiday for me," said Gus Wilson, as he untangled himself from the fishing rods and bait pails that were piled into the back seat

Why Your Car's Motor Gets Hot

SNAKE HILL was proving to much for Ed Crowley's car. It was steaming like a teakettle and mingled odors of hot oil and scorched paint came over the windshield.

"A swell fishing trip we're gonna have," groaned Joe Clark as Crowley drew over to the side of the road and set the hand brake. "Might've known this crate of yours would never get us to Round Lake."

Gus Wilson sitting in the rear seat, untangled himself from fishing rods, bait pails, and landing nets. Ed Crowley had convinced the two owners of the Model Garage that a day's vacation spent fishing would do them a world of good.

"Looks like a sailor's holiday for me," the grizzled garageman grumbled as he climbed to the ground.

"What did you do, Ed—forget to water the radiator this morning?" asked Joe.

"Not on your life." Ed protested as he loosened the radiator cap and squinted down the filler hole. "Filled her up just before we left. First time anything like this has happened in all my experience."

Gus walked to the front of the car and ran the palm of his hand over the radiator from top to bottom. "H'm. Water's not circulating at all," he muttered. "Pump must be on the blink or else the system is completely clogged."

Lifting the hood, he examined the motor carefully. "Here's a funny one," he exclaimed. Ed and Joe, drawing near, peered down at the motor over Gus's broad shoulders. He was pointing at the lower hose connection. The sides of the rubber tube were drawn in like the cheeks of a boy sucking a straw.

GUS poked the short tube with his thumb. "That hose is so old it's collapsed. Let's drain off the rest of the water and have a look."

Joe pulled a bait pail from the pile of fishing tackle and placed it under the radiator. Soon a muddy mixture of rust and water dribbled from the opened drain cock. Pliers in hand, Gus worked at the metal clamps that held the lower hose connection in place.

"There, what did I tell you?" he boomed triumphantly as he pulled the short rubber tube loose and held it up for inspection. "The inside's so rotten, it's falling apart. A layer of the fabric is wedged right across the opening like a flap valve. I guess the suction of the pump pulled it closed every time you stepped on the gas. If we cut that loose piece out I think your cooling troubles will be over—for a while, anyway.

"By the way, how's the fan belt?" he asked after he had completed the job and Joe had filled the radiator with water from a near-by farm pump.

ED CROWLEY tested the tension with his fingers. "Seems O. K.," he announced.

"Fine. Now, Ed, suppose you start her up and let's see how she runs," suggested Gus.

One touch of the starter button spun the motor into action. Gus removed the radiator cap again and peered down the filler hole.

"She's circulating all right now," he reported. "Give her more gas, Ed. . . . O. K. that's enough. . . . Now step on her again and slow down gradually."

"Say, what is this, a game?" Crowley protested as he opened and closed the throttle. "Why all the tests? If it works, it works."

"Just wanted to make sure the fan belt wasn't slipping," Gus replied as he fastened the side catches on the hood. "It turned the fan at low speed all right, but I wanted to make sure it didn't slip at road speed."

"How could it do one without the other?" Crowley asked, obviously puzzled.

"Ever hear of centrifugal force?"

"Sure. That's the force that makes the balls on a steam governor fly out when the engine speeds up," replied Crowley. "But what's that got to do with it?"

"Plenty," explained Gus. "A belt that doesn't slip at *(Continued on page 91)*

GUS says:

Every motorist must learn to park a car and to handle it in heavy traffic but a busy street is a poor place to pick for practice. Set up two rows of cereal boxes and see if you can drive between them backwards and forwards. Cereal boxes squash easier than mudguards and they cost considerably less

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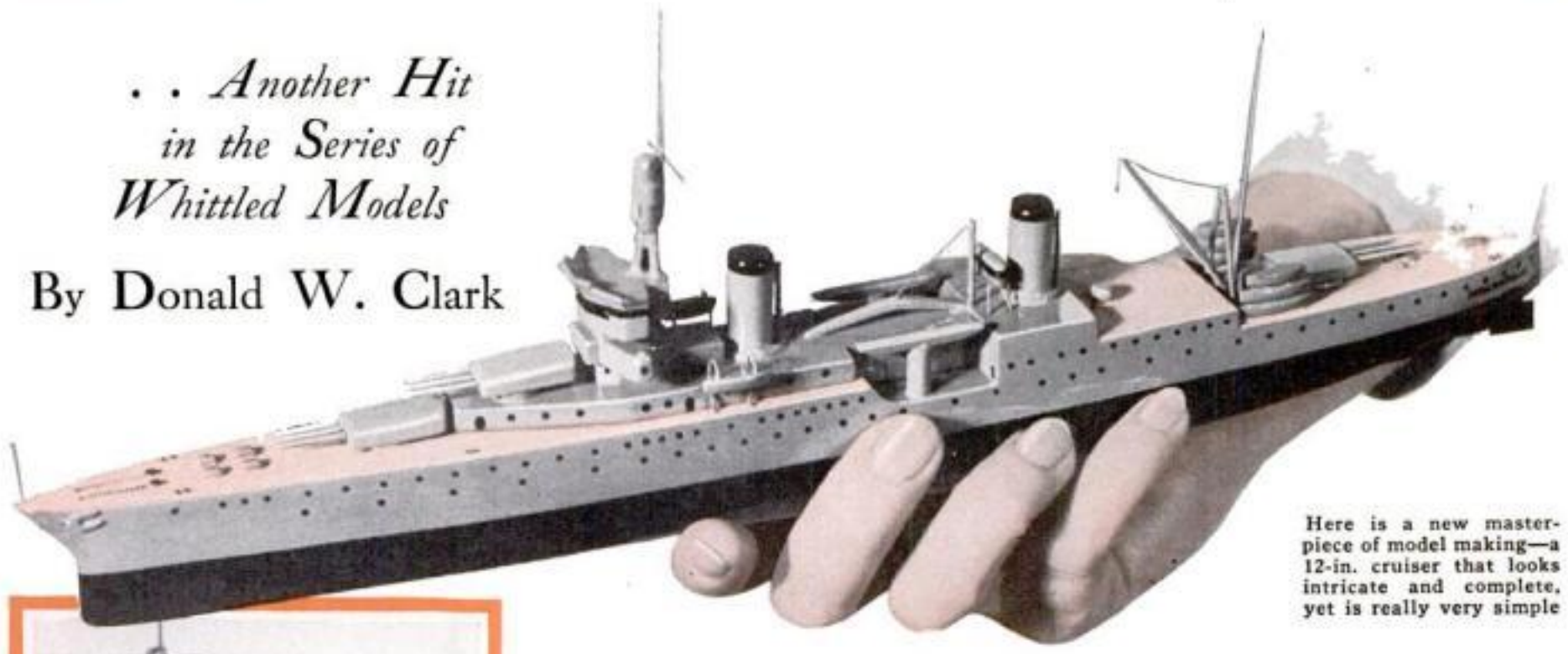
. . Another Hit in the Series of Whittled Models

By Donald W. Clark



Here is a new masterpiece of model making—a 12-in. cruiser that looks intricate and complete, yet is really very simple

Anyone can build this simplified

CRUISER MODEL U.S.S. *Indianapolis*

The *Indianapolis* model from the stern. It is exceptionally decorative from every angle

THE graceful, racy lines of the new 10,000-ton U. S. Navy cruisers offer an incentive to the model maker who likes to build modern ocean-going craft. The plans on the two following pages show how to construct a 12-in. model of U.S.S. *Indianapolis*, one of the more recently completed cruisers of the group. It is an excellent model for beginners to start with and will be found much easier to paint than the liner *Manhattan*, the pocketknife model described in one of the previous articles (P.S.M., Feb. '33, p. 63).

This cruiser model has but 96 parts, not counting the range finders on the turrets and part *S*, which may be omitted if desired. They are shown on the drawings, but were purposely left off the model illustrated in the photographs.

The methods of assembling and the materials are similar to those used for the *Manhattan* and also for the various airplane models described thus far in this series. The ordinary hand tools found in any home workshop, together with a pair of tweezers and a few single-edged razor blades, will serve for this job; in fact, most of the work could be done with a small, sharp pocketknife if necessary. Five sizes of white pine, thin aluminum, cardboard, soft wire, safety-match sticks, common pins, and a bit of thread complete the list of required materials. The itemized list appears on page 59.

Start the hull by sawing out a pine block a trifle larger than the blank or over-all dimensions, and plane it to the exact size. This is important in order to get the right shape. Mark a center line completely around the blank; also, mark the different deck levels, which should be cut in carefully with a fine-toothed saw and smoothed with a file.

Next mark the profile lines of the bow and stern on the blank and cut to these accurately. Be very careful not to cut too deep at the stern. Draw the curves of the top plan on thin cardboard, cut them out, and trace around them on the blank. By using a long-pointed pencil, you will have no difficulty in putting the stern lines on in spite of the different deck levels. Carve away the excess wood up to the lines thus drawn, and round the bottom edges amidships to a radius of 3/16 in.

Taper the bow and stern, using your eye to keep the contour true. Cup the sides of the bow a little as shown, and be careful to preserve the keel and rudder support at the other end. Smooth with medium and then fine sandpaper. Use two smooth pieces of wood to clamp the hull in your vise when tapering the blank

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or drilling the necessary holes.

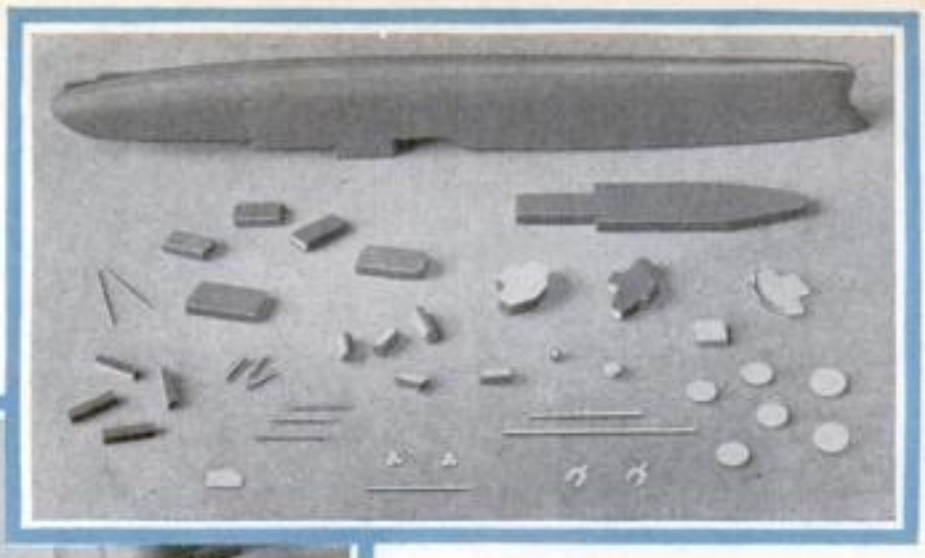
You will need a strip of pine 3/16 by ⅞ by 11 in. long to make units *B*, *C*, *D*, *E*, *G*, *J*, and the turrets. It is easy to cut these out with a ruler and a razor blade. True them up afterward with a small sandpaper block. I found that a small tray in which to put the parts after they are finished is quite useful and prevents the tiny pieces from getting lost.

Cut the two funnels from round wood 11/32 in. in diameter. If you can't get this size, it is not hard to plane down a larger diameter or even a square piece, as was done on the original model. The catapult towers, the lookout *I* and detail *K* should be cut from 3/16 in. diameter wood. The catapult tracks, derrick booms, and details marked *P* can be made quickly from safety-match sticks.

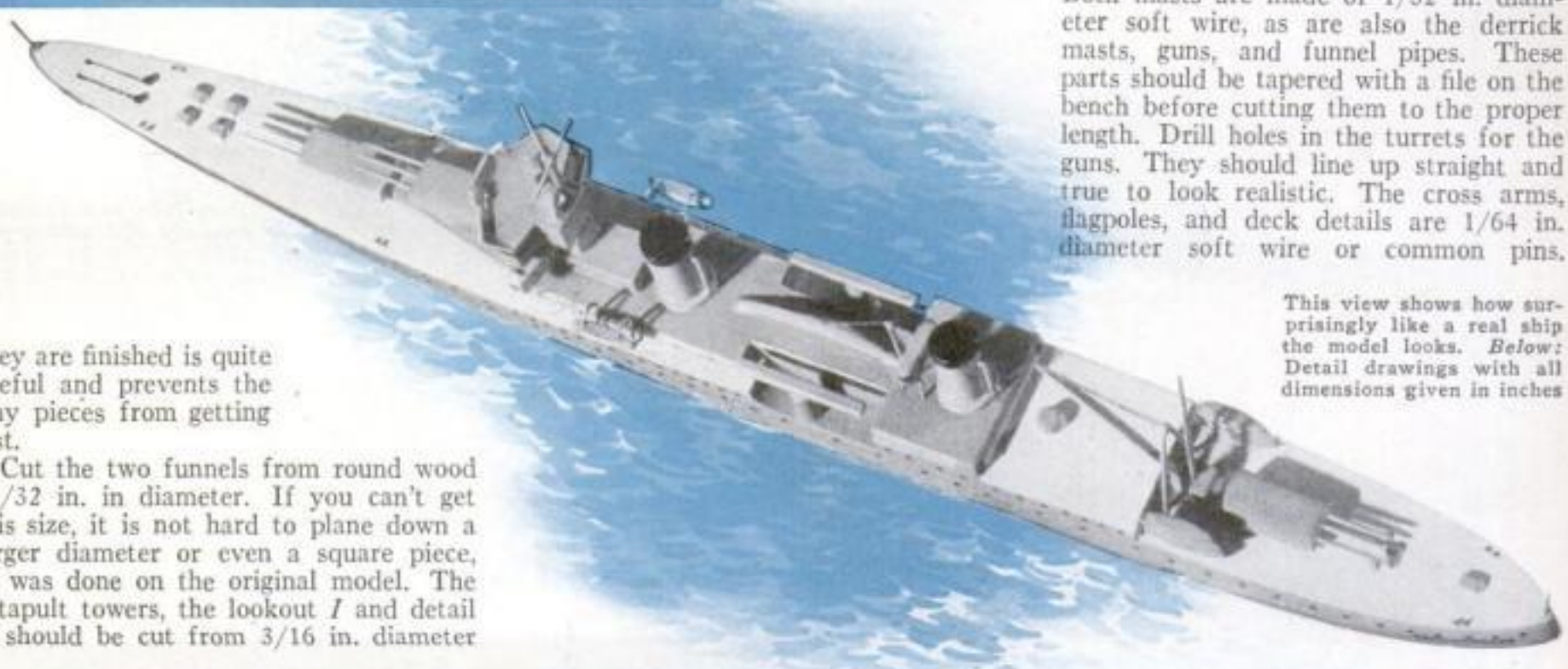
Slice off a ⅛-in. strip of ⅛-in. pine 8 in. long for making the lifeboats, and note that there are two different lengths. These can be shaped with a blade and finished with fine sandpaper, but be sure to drill the davit holes in two of the short ones before doing the carving.

Cardboard is needed for the funnel bases, turret mounts, units *H*, *F*, and the top part of unit *G*. The band on unit *I* is made of paper, a glued strip of which is wrapped around two or three times. Detail *S* at the top of unit *I* is a bit of match stick. The supports for *I* should be 1/16 in. diameter wire, the three pieces being set into holes in top of *G*.

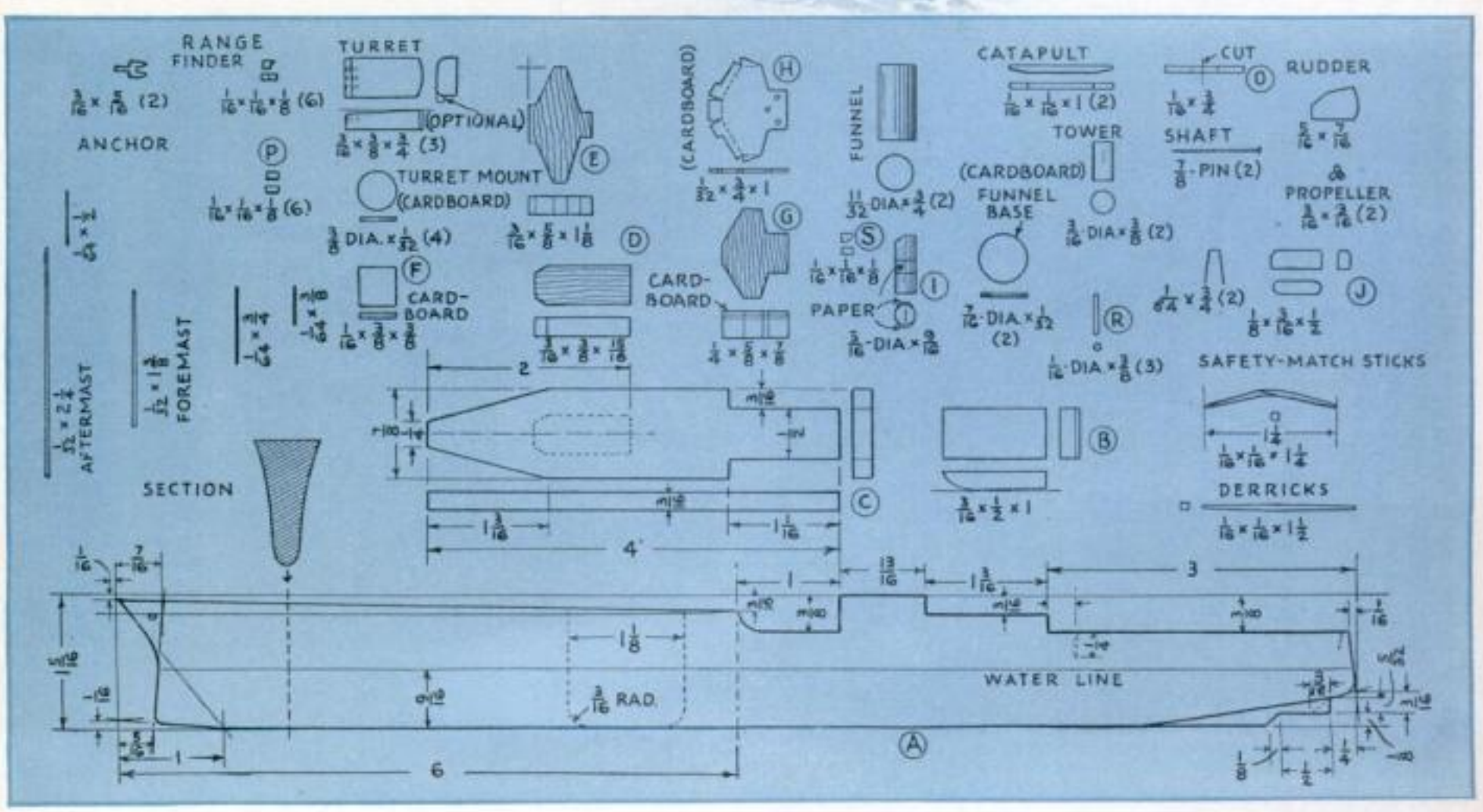
The foremast is glued to the back of *I*. Both masts are made of 1/32 in. diameter soft wire, as are also the derrick masts, guns, and funnel pipes. These parts should be tapered with a file on the bench before cutting them to the proper length. Drill holes in the turrets for the guns. They should line up straight and true to look realistic. The cross arms, flagpoles, and deck details are 1/64 in. diameter soft wire or common pins.



The finished hull block turned upside down, and most of the small parts. *At left:* Setting the main derrick support into the hull. The gun turrets, turret mounts, and masts also appear



This view shows how surprisingly like a real ship the model looks. *Below:* Detail drawings with all dimensions given in inches



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List of Materials

Dimensions	No. Pc.	Material
1⅛ x 1 5/16 x 12	1	White pine for *A*
3/16 x ⅞ x 11	1	White pine for deck units *B*, *C*, *D*, *E*, *G*, *J*, and turrets
⅛ x ⅛ x 8	1	White pine for lifeboats
11/32 dia. x 2½	1	White pine for funnels
3/16 dia. x 2	1	White pine for towers, *I*, and *K*
1/32 x 1 x 1⅞	1	Sheet metal for rudder, propellers, shaft braces, and anchors
1/32 x 1¼ x 6	1	Cardboard for funnel bases, turret mounts *F* and *H*, and top of *G*
1/16 dia. x 2	1	Soft wire for *R*
1/32 dia. x 10	2	Soft wire for masts, derricks, guns, and funnel pipes
1/16 dia. x 10	1	Soft wire for davits, cross arms, and flagpoles

Common pins, safety-match sticks, and thread. Small cans or tubes of enamel (or paint) in navy gray, black, and buff.
Note: All dimensions are given in inches.

Use thin aluminum or other sheet metal from which to cut the anchors, rudder, propellers, and shaft braces. This work is the only part of the task which calls for extreme patience, but it can be done without much trouble. Mark out the parts with a scratch awl, drill holes, and saw out roughly with a fine-toothed coping saw or jeweler's saw. Then finish the parts with a fine file. Two pins serve for propeller shafts. The braces are pushed into slots in the hull. The propellers will be held in place by the paint, and this and a little glue will hold the rudder securely.

All the wood and cardboard parts should be fastened with casein glue or a good household cement. Most of the metal parts are set into holes which are deep enough to hold them rigid.

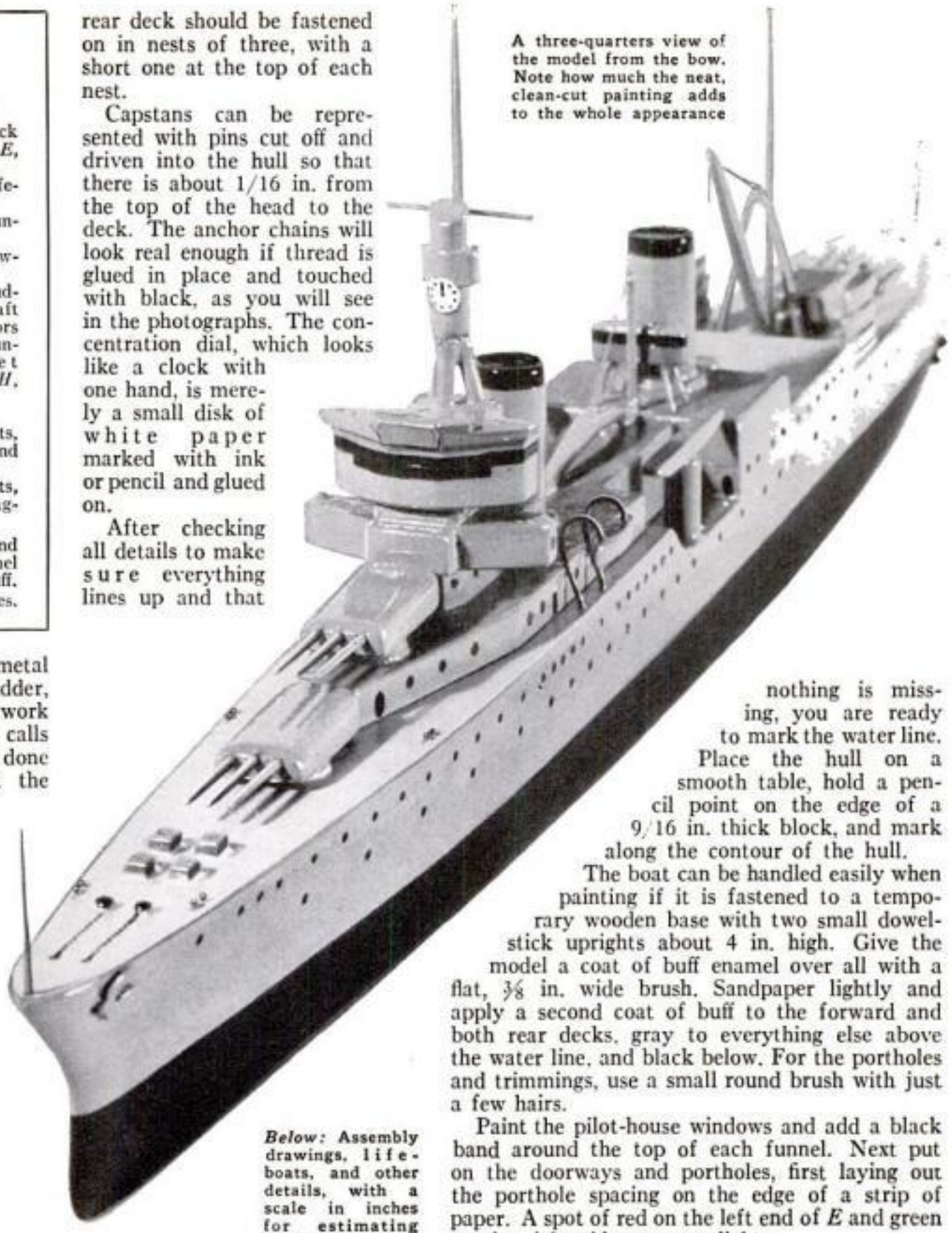
The forward lifeboat davits can be bent from the rounded ends of small hairpins. The boats on the rear deck should be fastened on in nests of three, with a short one at the top of each nest.

Capstans can be represented with pins cut off and driven into the hull so that there is about 1/16 in. from the top of the head to the deck. The anchor chains will look real enough if thread is glued in place and touched with black, as you will see in the photographs. The concentration dial, which looks like a clock with one hand, is merely a small disk of white paper marked with ink or pencil and glued on.

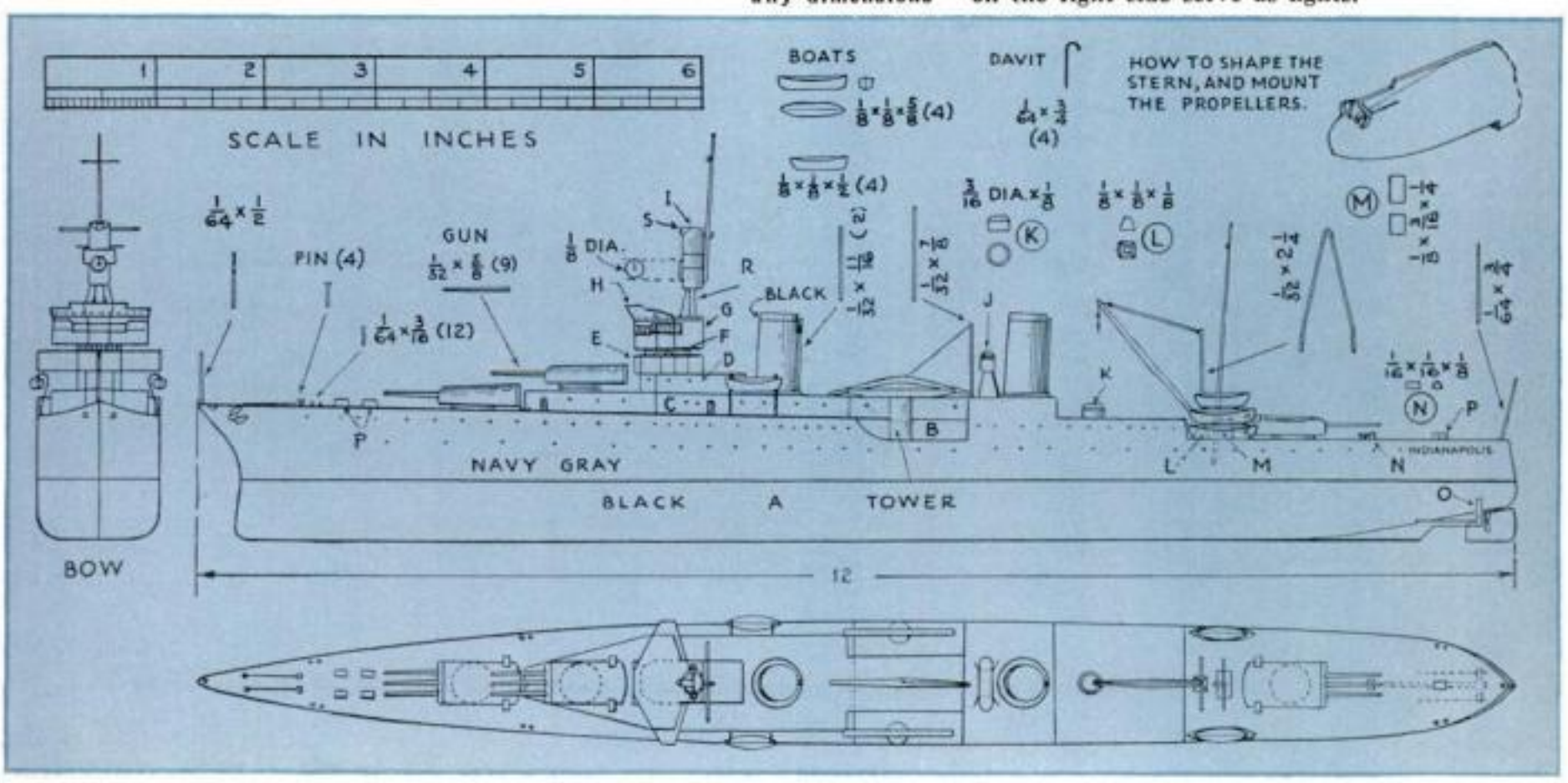
After checking all details to make sure everything lines up and that nothing is missing, you are ready to mark the water line. Place the hull on a smooth table, hold a pencil point on the edge of a 9/16 in. thick block, and mark along the contour of the hull.

The boat can be handled easily when painting if it is fastened to a temporary wooden base with two small dowel-stick uprights about 4 in. high. Give the model a coat of buff enamel over all with a flat, ⅜ in. wide brush. Sandpaper lightly and apply a second coat of buff to the forward and both rear decks, gray to everything else above the water line, and black below. For the portholes and trimmings, use a small round brush with just a few hairs.

Paint the pilot-house windows and add a black band around the top of each funnel. Next put on the doorways and portholes, first laying out the porthole spacing on the edge of a strip of paper. A spot of red on the left end of *E* and green on the right side serve as lights.



A three-quarters view of the model from the bow. Note how much the neat, clean-cut painting adds to the whole appearance



Below: Assembly drawings, lifeboats, and other details, with a scale in inches for estimating any dimensions

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MINIATURE PILOT WHEEL OPERATES SWITCH OF NOVEL TABLE LAMP

TURN the pilot wheel on this small lamp stand and the light comes on; turn it again and the light goes off.

The lamp is made entirely on a wood turning lathe. All that is required are a few pieces of wood, preferably mahogany, cherry, or some other cabinet hardwood, a chain-pull socket, and a ⅛-in. pipe nipple 1 in. long.

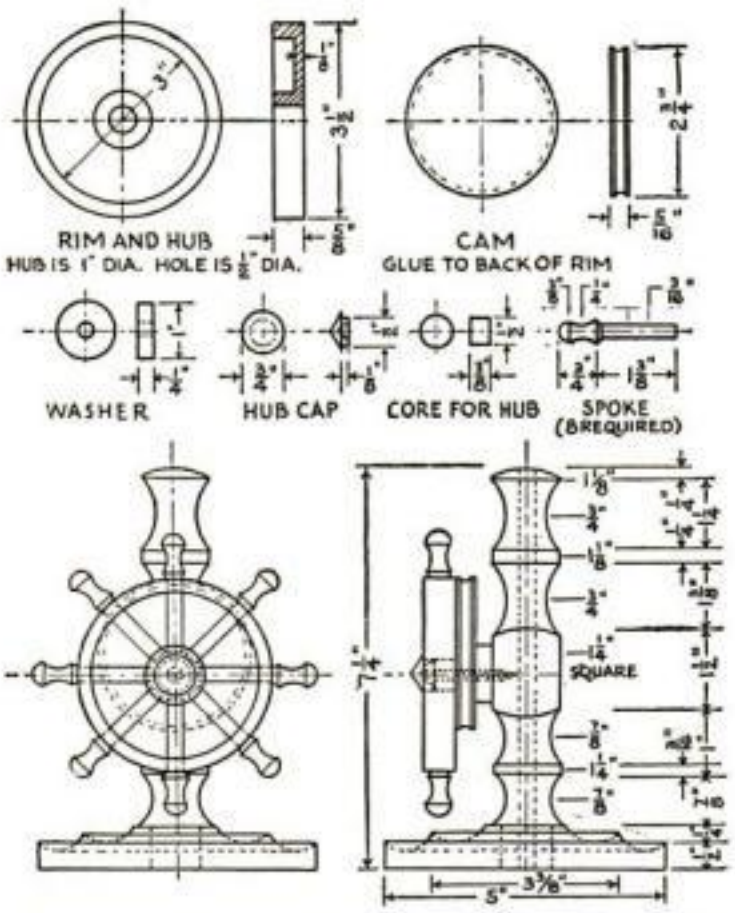
Obtain a piece of wood 1¼ in. square and 8 in. long and bore a ¼-in. hole through it lengthwise. Plug the ends of the hole and turn the upright piece as shown in the accompanying drawings. Then turn the base and glue the two pieces together.

In making the wheel it is best to glue the piece from which the rim and hub are to be cut to another piece of wood, and fasten this piece to the faceplate. After the piece has been turned, saw it off just back of the glue joint and scrape and sandpaper all the glue off. Divide the rim into eight equal parts and drill 3/16-in. holes through rim and hub for the spokes. Turn the core for the hub, preferably out of a piece of hardwood, and glue this in place.

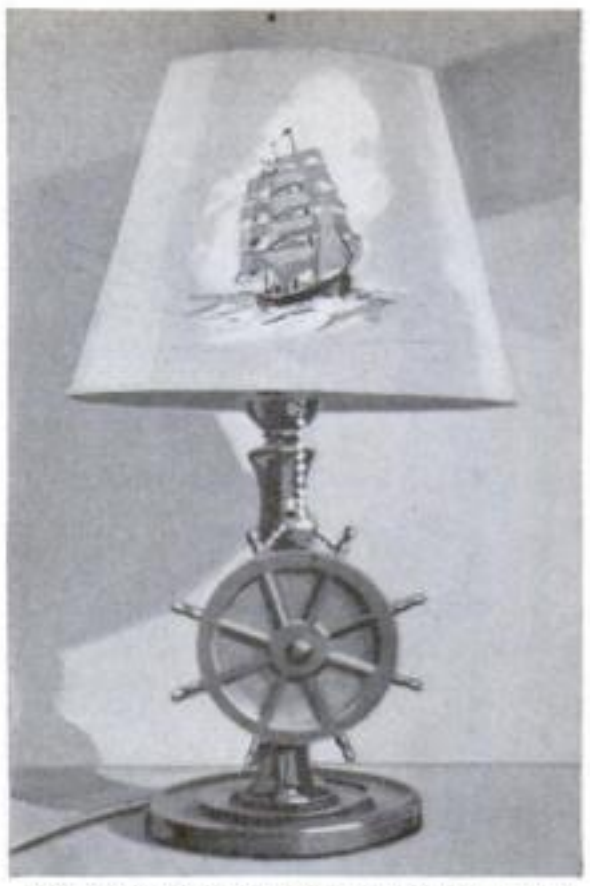
In turning the spokes be sure that your tools are very sharp, otherwise you will encounter trouble. By taking extremely light cuts while the wood is revolving very fast, you can turn the spokes to the approximate size and then sandpaper them to the exact size. Place the end of a spoke through the rim, apply a drop of glue to the end and around the portion that goes into the rim, then push the spoke into place. After all spokes are in position, allow time for the glue to dry.

Make the cam, following the same procedure outlined for making the rim and hub, and glue it on the rear side of the rim as shown in the assembly drawing. The washer and hub cap are also made on the faceplate.

In assembling, drill a hole through the hub and cam large enough for a 1½-in. No. 8 roundhead screw. Slip the washer on the screw and fasten the wheel to the lamp standard. Glue the hub cap in place, thus hiding the head of the screw.



Front and side views of the assembled lamp and details of the rim and hub, the cam, the spokes, and other parts



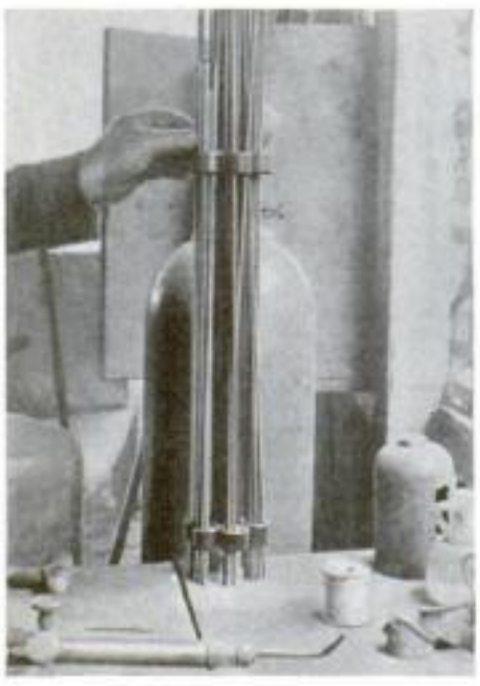
The pilot wheel on this lamp is more than a decoration; it turns the light off and on

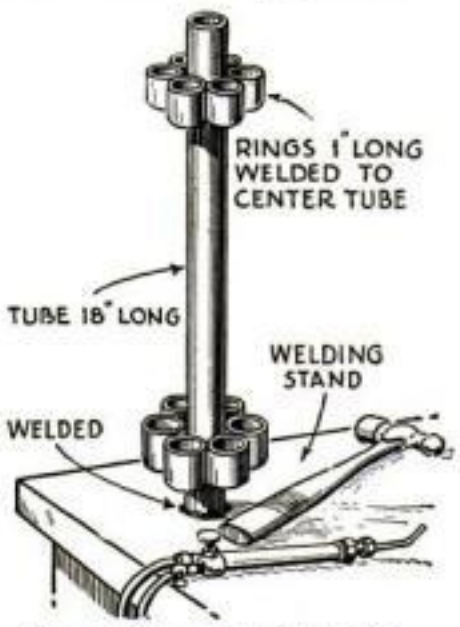
A chain-pull socket is fastened to the lamp standard by using a ⅛-in. pipe nipple 1 in. long. Simply screw the nipple into the hole, which should be enlarged to fit. Replace the short chain that comes on the socket with an extension chain sold for use with chain-pull sockets. The extension chain comes with a suitable connector.

Be sure to adjust the chain so that, as the cam is rotated by turning the wheel, the chain is pulled down enough to work the socket. You will find that nearly everyone who lays eyes on the lamp will just have to see if it actually works.—W. T. BAXTER.

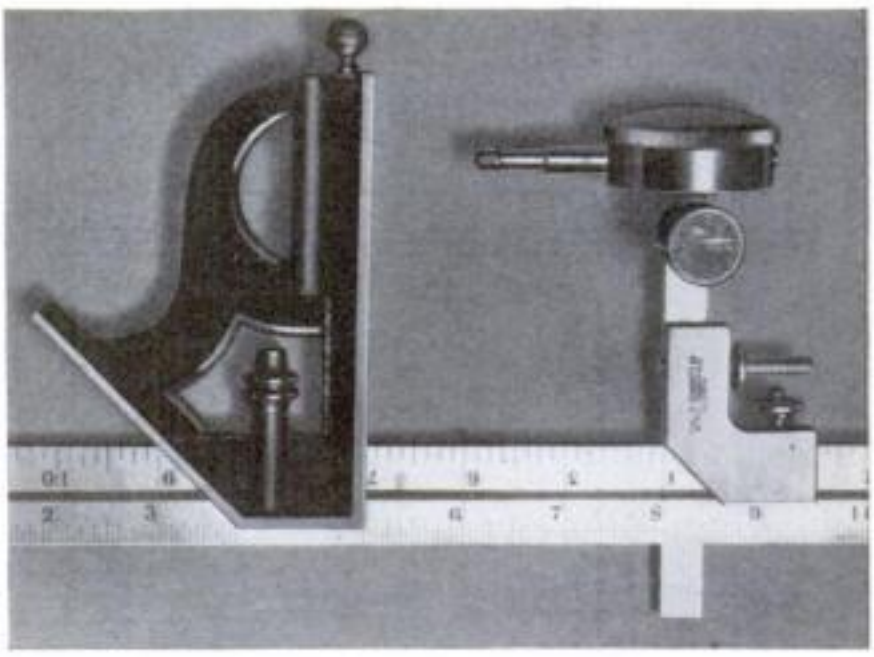
ROD HOLDER FOR WELDING BENCH

WHERE a metal topped welding stand is used, a convenient rod holder may be made by welding the end of an 18 in. long section of tubing to one corner of the stand, as shown below. Then 1 in. long rings of the same tubing are welded close together around the top of the long central tube, and another series of short tubes is welded near the bottom. These hold long sections of rod in plain view, ready for use, so that a selection may be made instantly. The holder should be neatly painted.





The welding rod holder in use and, above, a drawing of the device to show construction



DIAL GAGE MOUNTED ON SQUARE

BY THE method illustrated above, mechanics can provide themselves with a handy dial gage for either inside or outside measurements, as well as for use as a depth or height gage. The dial gage proper is fastened to a standard combination-square attachment with a piece ⅛ by ⅜ in. and 4 in. long. This can be clamped to the gage by a single ¼-in./20 machine screw if the dial gage happens to be of the kind shown. This arrangement is excellent for testing out-of-round pistons or pins, as, unlike a micrometer, it does not need constantly to be adjusted.—M. L. BLUMSTEIN.

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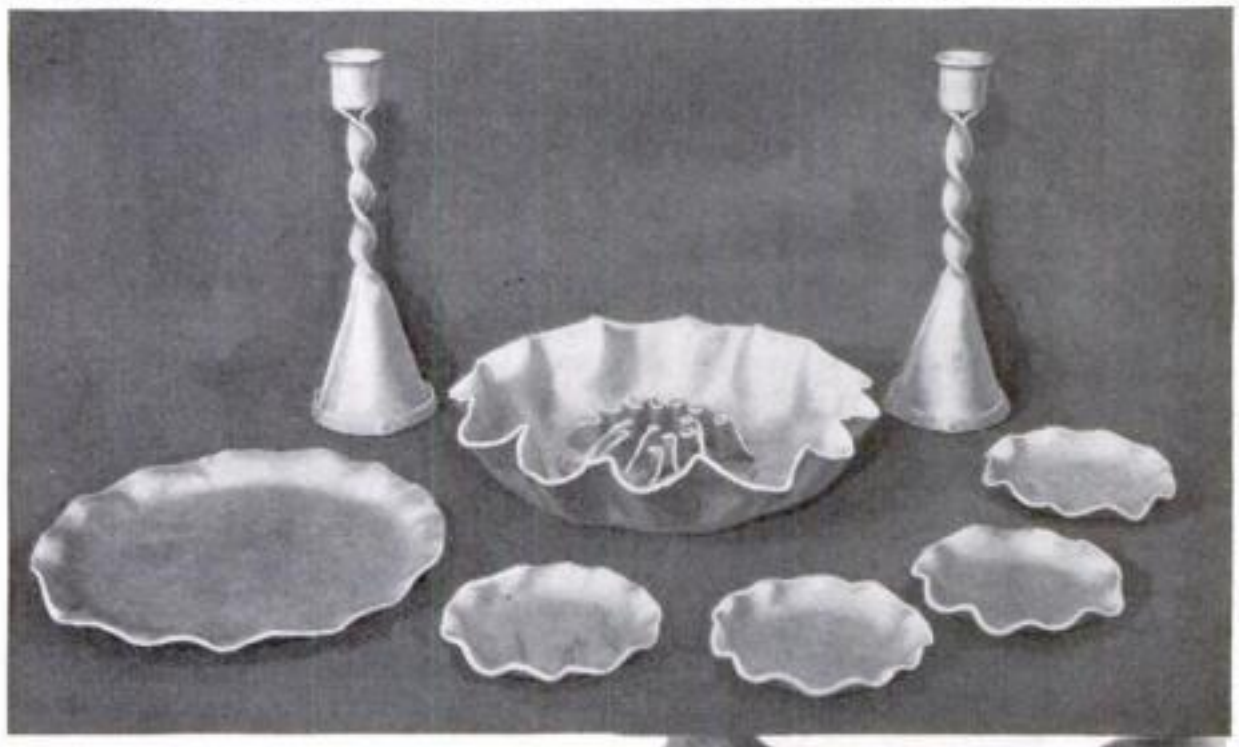
Flexible Flower Bowls

SHAPED FROM SHEET LEAD WITH YOUR FINGERS

A new type of craftwork in metal that requires no special tools or skill—Candlesticks and a large variety of decorative and useful objects may also be made at slight cost

By

DICK HUTCHINSON

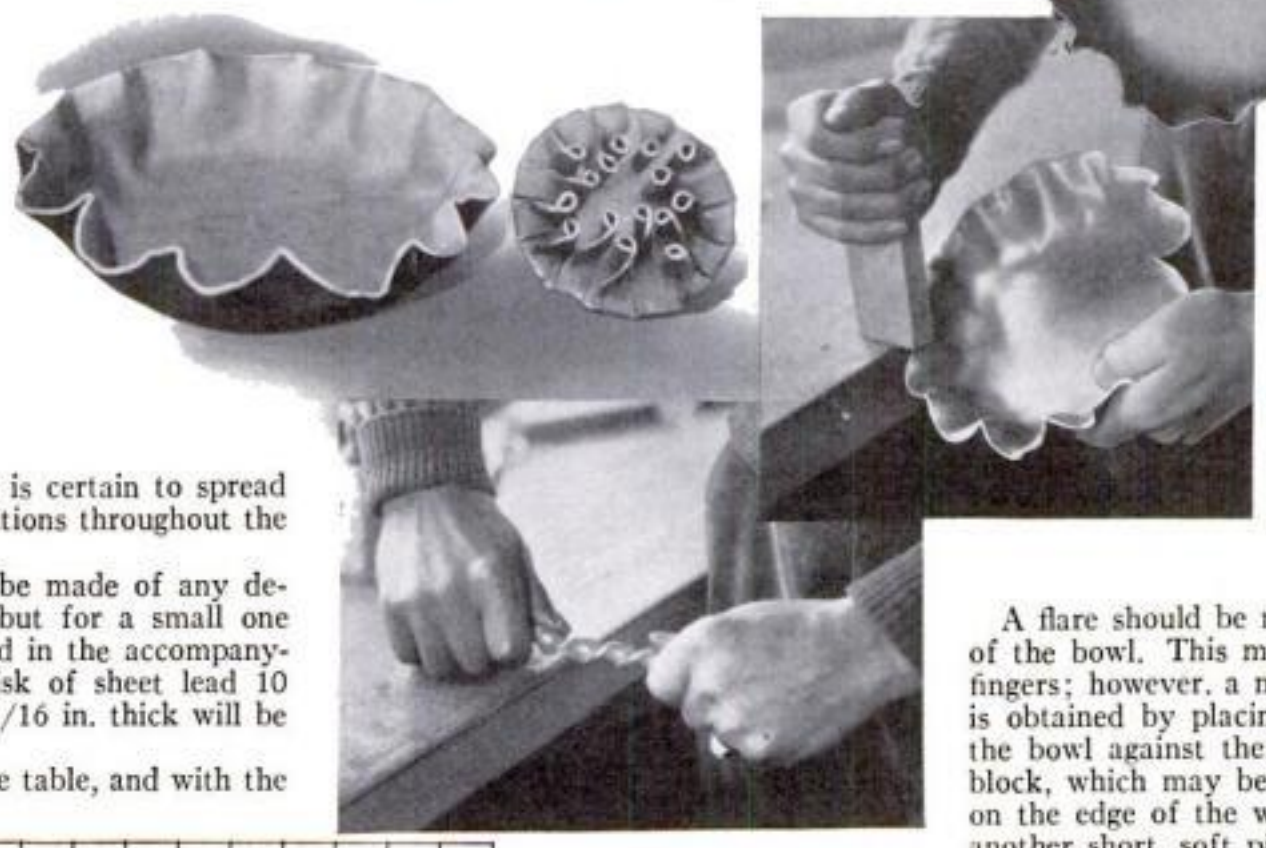


HERE is a new type of decorative metal work that anyone can do. It requires no tools other than a pair of ordinary shears, and the material is comparatively inexpensive—thin sheet lead such as can be obtained at almost any plumbing shop.

Simple as this type of metal work is, the finished articles have a charming handmade quality, and in exclusive gift shops and department stores they command prices far out of proportion to the cost of the materials. Flower growers are especially partial to lead bowls because they can be bent by hand into a shape that will best suit the flowers they are to contain. In fact, the use of lead bowls on the part of exhibitors at this year's International Flower Show in New York attracted much attention. The practice is certain to spread to other flower exhibitions throughout the country.

Flower bowls can be made of any desired size or shape, but for a small one of the type illustrated in the accompanying photographs a disk of sheet lead 10 in. in diameter and 1/16 in. thick will be sufficient.

Lay the lead on the table, and with the fingers bend up about 2¼ in. all the way around. Naturally, this operation will kink the material, but by working slowly and carefully the kinks may be distributed evenly with the thumb and fingers. That is, make each kink or scallop about the same width. Keep working around and around until the sides are approximately straight up and down.

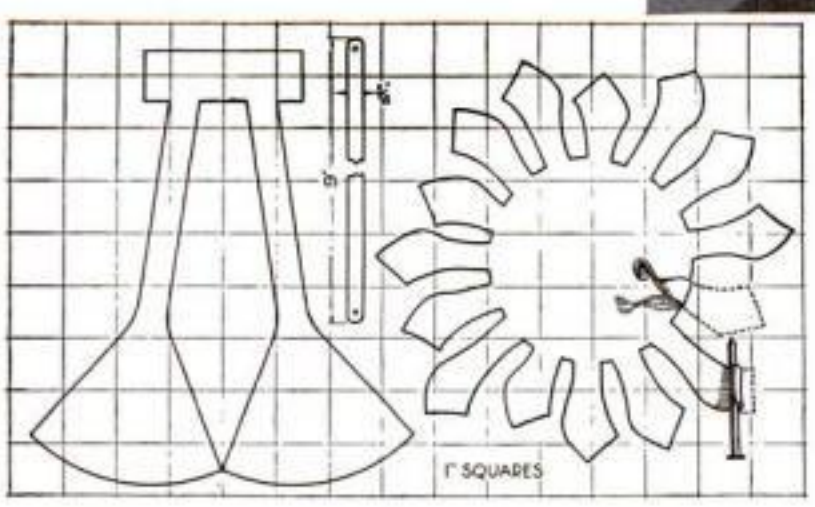


How the rim of the bowl is bent up in a series of scallops. *Above:* A set of lead pieces, including candlesticks and trays

Left: The flared edge around the top of the bowl may be shaped up by using a soft pine block as a hammer

A flare should be made around the top of the bowl. This may be done with the fingers; however, a more attractive effect is obtained by placing the outer edge of the bowl against the edge of a soft pine block, which may be held in the vise, or on the edge of the workbench, and using another short, soft pine block to hammer the top edge out to form a flange. This is illustrated in one of the photographs.

The holder for the flowers will require a piece of 1/16-in. sheet lead 8 in. square. Lay out the pattern on a piece of cardboard divided *(Continued on page 78)*



Above: The completed bowl and separate flower holder, and how the stems of the candlesticks are twisted. *Left:* Patterns for the candlesticks and the strip riveted around the base of each, and a layout for the flower holder

Four pieces of a type sold in many gift shops. The ease with which sheet lead may be cut and bent is an encouragement to work out designs of your own

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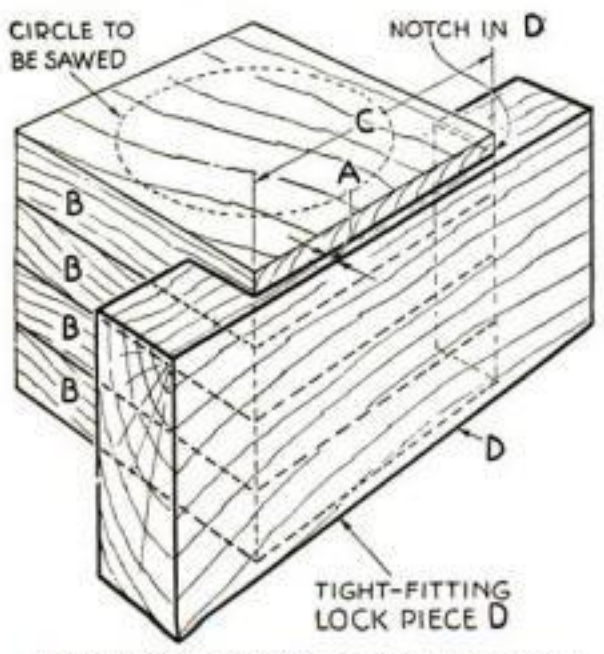
PROPELLERS

Sending up kite propellers to twirl on string

HOLDING SMALL PIECES FOR BAND-SAWING

WHEN a number of pieces are to be band-sawed, it is best to cut several at once. This saves time and insures uniformity. A good method of holding small pieces for sawing is shown in the photograph at the right and the drawing below.

The pieces marked *B* must be cut to the same width or length, preferably on the circular saw. A clamping piece *D* is then notched out to receive the others tightly. The notch must be carefully cut, the dimension *C* being just a hair less than the width of blocks *B*. The dimension *A* is made small enough to permit springing block *D* in place, yet stiff enough to hold the material tightly. Only the top piece need be marked, of course, and the entire assembly is fed to the saw and cut out as a unit.—JOHN E. HYLER.



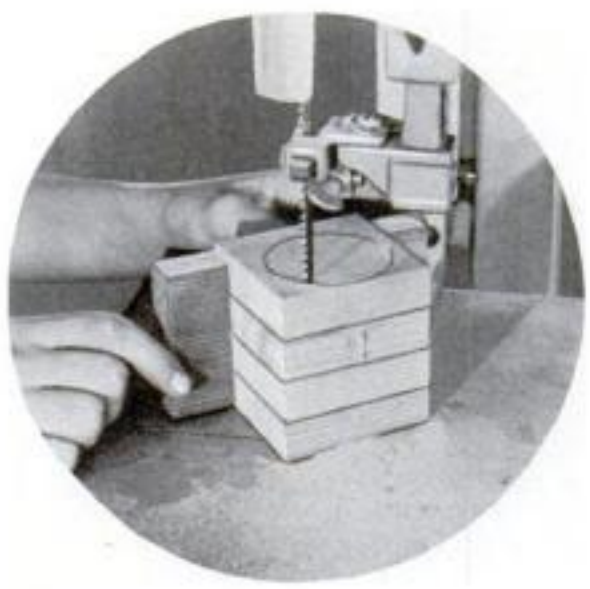
Piece *D* is thin enough at *A* to spring over ends of blocks *B* and hold them securely

WHIRL UP TO KITE

KITE propellers of balsa wood or any other very light wood will greatly increase the interest of kite flying. These propellers may be of any convenient size. A propeller 6 in. long with the blade approximately ¾ in. wide has been found generally satisfactory.

A hole is drilled in the center of the propeller for the kite string. When the kite is in the air, the end of the string can be passed through the hole, and the wind will twirl the propeller and carry it rapidly up the string to the kite, where it will continue to rotate as long as the kite is in the air. A series of propellers may be sent up to the kite until their weight becomes too great.

Another way of using them is to place knots in the kite string at, say, 100-ft. intervals. Use one propeller between each pair of knots and place a small glass bead between each propeller and the knot ahead of it. As the kite string is unwound, each propeller will twirl and follow up to the next knot, where the bead will act as a thrust bearing. The kite string will have a unique and attractive appearance with propellers whirling at spaced intervals along it, especially if the propellers are brightly colored with either enamel or lacquer.—WILLIAM E. GALBREATH.



These four blocks being band-sawed at once are held together by a notched piece of wood

GRACEFUL FRUIT HOLDER MADE ON JIG SAW

A JIG saw and sandpaper are the only tools—if sandpaper can be called a tool—necessary for making the wooden fruit "basket" illustrated at the right. It will serve equally well as a stand for a fish bowl or a flower pot.

A fairly hard, close-grained, strong wood should be used. The hoop and legs are cut from ½-in. stock, but the bottom is only ¼ in. thick. The hoop that fits around the top may be made from one piece of wood, but is much stronger if made of three sections, as shown in the drawings, and glued together. In laying out the sections, arc ABC is found by stepping off OA twice on arc AX. Note that the grain meets at each joint in such a way that one piece reënforces the other.

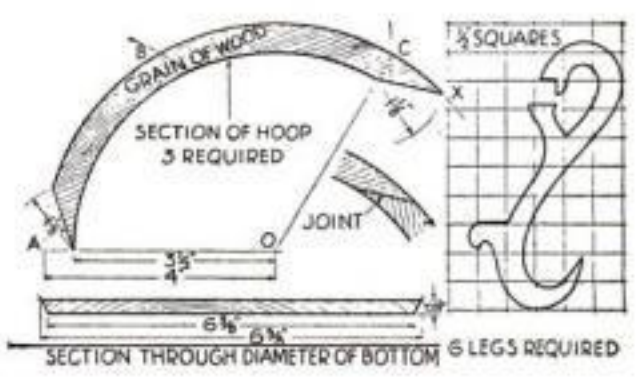
Round all sharp edges slightly. In the case of the holder I made, which was intended for fruit, I applied a lettuce green lacquer.—BILL CHANEY.

FIREPROOF DEPOSIT BOX SET IN CELLAR WALL

A FIREPROOF deposit box can easily be built in some out-of-the-way place in the basement of your house—for example, between shelving where fruit jars will conceal it when inclosed. Obtain a suitable metal cash box and cut a hole through the masonry to hold it. Make, or have a tinsmith make, a watertight lining of 24- or 26-gage galvanized sheet metal to fit the opening in the wall and long enough to hold both the box and the door, which is to be made later. Fill the space between the lining and the wall with cement mortar. The front, of course, is open.

Next make a cement door 5 in. thick to fit the finished opening of the wall. A door with a handle like the one shown requires a piece of sheet metal 1 in. larger all around than the opening. Rivet a handle to the center. Put four sixteenpenny nails through from the handle side about 2 in. from each corner and bend a hook near the point of the nails so they cannot pull out when the cement is set. Make a form of 5-in. light boards to fit the opening and place it on the metal around the protruding nails. Fill the form with cement mortar and let it harden for several days.—LEWIS SHIRLEY.

This unique ornamental fruit holder or stand won second prize in our recent Jig-Sawing Contest



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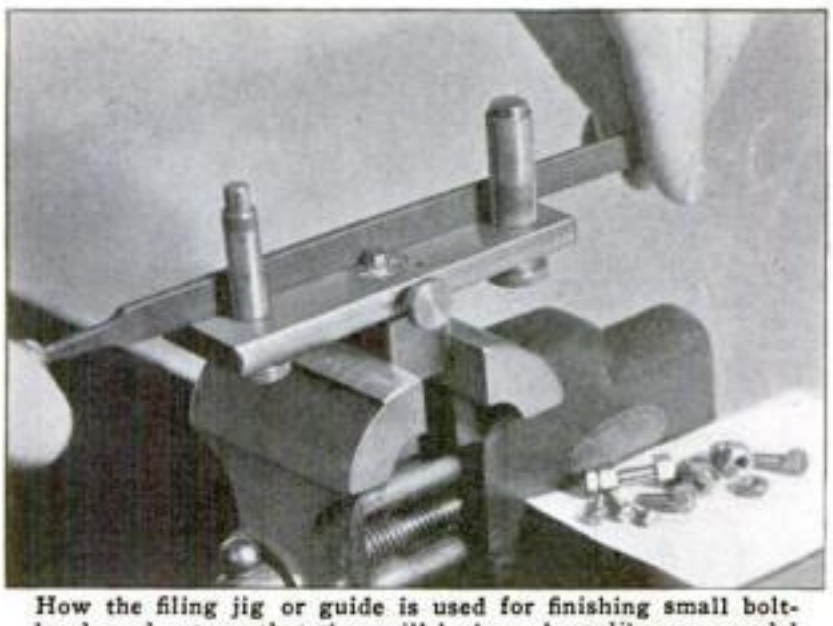
Roller Guide Aids in Filing Small Nuts and Bolts for Models

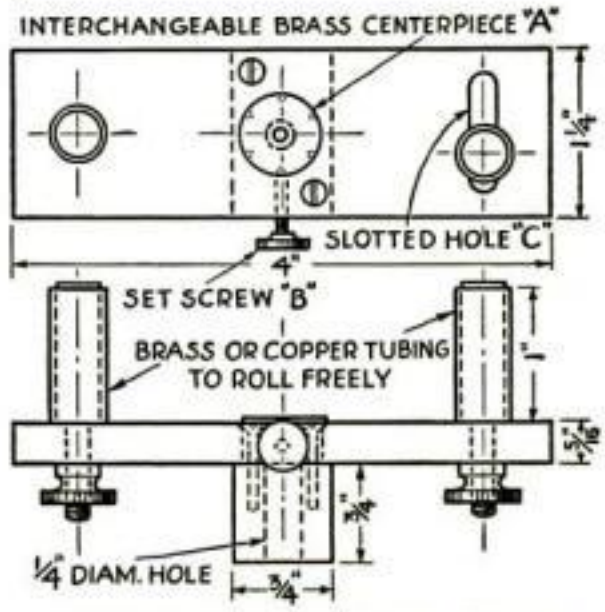


How the filing jig or guide is used for finishing small bolt-heads and nuts so that they will look workmanlike on a model

WELL-FINISHED and accurately made nuts and bolts add greatly to the attractiveness of a model engine or any other mechanical model, but hexagon nuts and bolts in the smaller sizes are both expensive and hard to obtain. A filing jig or guide that will make the production of accurate hexagons or squares a simple operation for the model builder is illustrated. This device was made from material found in the scrap box.

It is in reality a jig similar to those used in some factory operations. Two rollers guide the file and regulate the depth of cut. The brass centerpiece *A* is provided with a tapped hole in its exact center to receive the screw to be shaped. Shallow holes carefully spaced with a pair of dividers (six holes for hexagons, four for squares, etc.) are engaged by screw *B* and serve for indexing and locking the work while each face is filed. The slotted hole *C* allows one of the roller pins to be moved to suit work of various sizes.

To make nuts, a threaded pin or stud is inserted in the tapped hole in *A*. Tapped blanks are then made from round stock, screwed on, and tightened with a pair of pliers.—W. CHUBB.



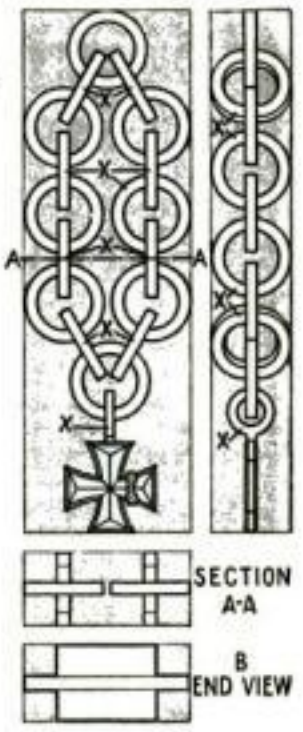
Working drawings of the filing jig. Set screw *B* engages indexing holes in centerpiece *A*

ENDLESS CHAIN CUT FROM ONE BLOCK

DIFFICULT as it looks to be, this endless chain and cross can be carved from one piece of wood by anyone who will go at it systematically and patiently. Get a straight-grained block 1½ by 3⅛ by 10 in., preferably mahogany or walnut. Mark both ends as shown at *B* and plane away the shaded parts with a rabbet plane. Mark off the rings *X*, eight of which are 1½ in. in diameter and one ⅞ in. in diameter. All are to be ¼ in. wide and ¼ in. thick. Cut down between the rings with a coping saw and chisel out the wood in between as shown in the edge view. You will now have what amounts to a board ¼ in. thick with nine half-round disks projecting on both sides.

Next mark off the other eight rings, which are all 1½ in. in diameter. This you can do with a pair of dividers. Don't cut away all of the wood outside the rings at one time—only sufficient to allow you to cut loose one ring at a time, otherwise the wood is likely to break. The last thing to cut out should be the cross, because it comes in handy to clamp in the vise while you cut the rings. After the rings are all cut loose from one another, round them nicely with a chisel and smooth with sandpaper. The cross can be left plain or carved out as shown. It is 3/16 by 1¾ by 1¾ in. Any type of ornament, of course, may be substituted.—WILLIAM HARVEST.

The completed chain and, at right, drawings in which the tinted areas show how the wood is cut away. The links could be cut oval instead of round



The wire is run twice through the tire, drawn tight with a hammer, then bound with soft wire and soldered at the joint after the ends of the rubber are wedged far enough apart to insert iron

REPLACING TOY TIRES

THE wire that holds tires on small tricycles, bicycles, and other toy vehicles often breaks, and the only satisfactory way to replace the tire is to put in a new wire.

The tire is usually a little longer than the rim. Do not cut it off, or there will be a gap where the ends meet. Take a piece of wire a little smaller in diameter than the original one and run it through the tire twice, so as to make two complete loops. Draw it as tight as you can with a claw hammer. Have someone hold it while you wrap a piece of soft wire around where the ends cross. Then bend the ends of the heavy wire over the lashing, and cut off the excess wire. The joint must then be soldered securely. This can be done by wedging the tire back so that a soldering iron can be inserted. After the soldering has been done, the ends of the tire can be worked back over the joint so no opening remains.—LEROY VAN TASSEL.

COCONUT TWINE HOLDER LOOKS LIKE OLD INDIAN MASK

FROM one of the fibrous hulls in which coconuts grow it is possible to make a novel twine or yarn holder or a sewing kit that resembles an old and grotesque Indian mask. A raw coconut hull and a finished sewing kit are shown in the accompanying illustration. The back of the hull is cut off to give access to the hollow interior, and in this the twine is placed. The earrings, teeth, and eyes are made of small shells. The headdress is a red pincushion in this case, although colored feathers could be used effectively. The finished holder appears to best advantage if hung against a wall, but it may be laid down on a table or shelf.—D. A. BUTLER.

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Camera Case

By KENNETH MURRAY

Fig. 1. There is an expensive, handmade look about this unique camera carrying case, yet it is easy to construct

Fig. 2. The camera case consists of one wide piece of plaited leather laced to two solid leather side-pieces with thongs. The inside is lined with suède. A neat metal catch keeps the case shut. The shoulder strap is also plaited to harmonize with the case

Fig. 3. The outside piece, which is of 4-oz. strap leather, is cut into twenty-six narrow thongs with a sharp blade. A strip 1 in. wide is left whole at one end

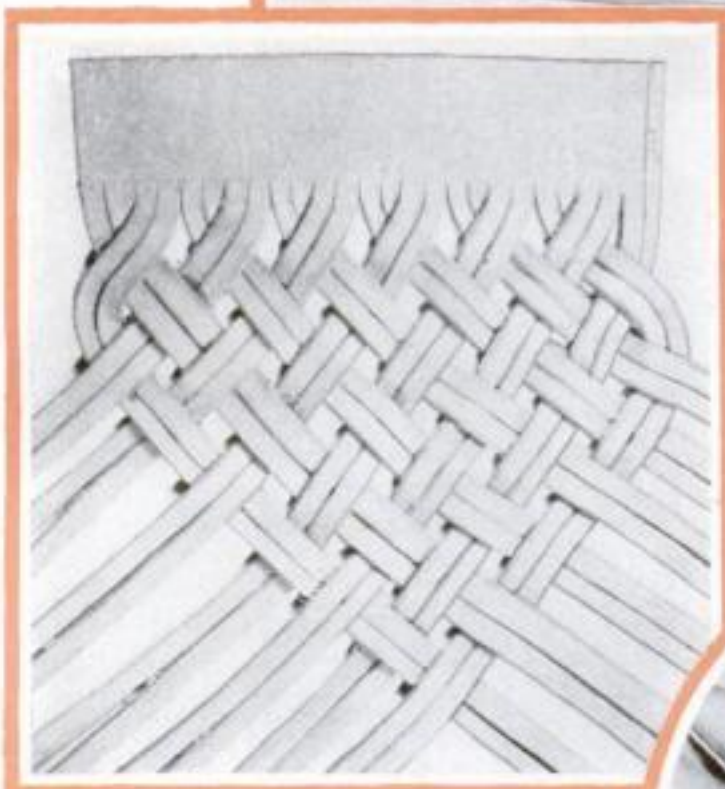
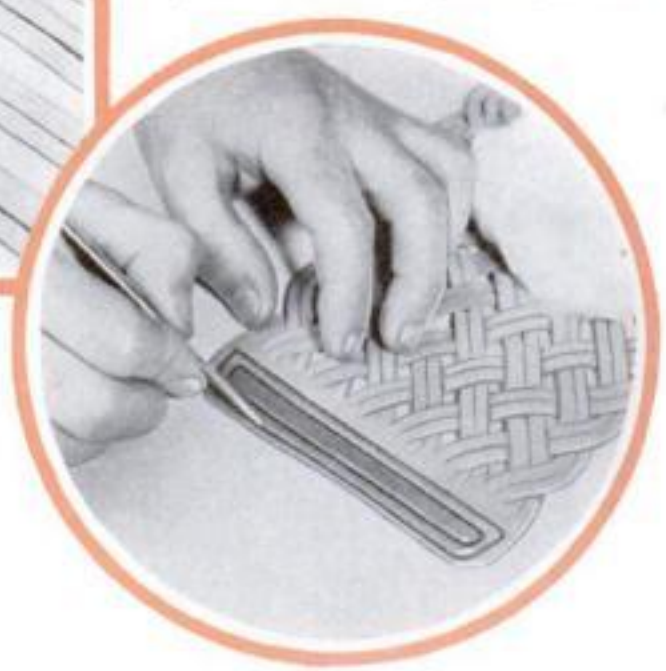


Fig. 4. The plaiting is started as shown at the left. If there is any difficulty in making the thongs stay in place, apply a little cellulose cement

Fig. 5. Tooling border lines on the moistened strip of leather left intact at one end of the plaited piece. You may add a name or monogram if you wish



THIS novelty camera case is ruggedly constructed and will wear for many years. Its unusual appearance (Figs. 1 and 2) is simply the result of cutting a piece of soft strap leather into thongs and plaiting or weaving them together.

The measurements that follow are for a case to hold a No. 1 kodak. In figuring the amount of leather required for other models, it should be remembered that the thongs lose approximately one third of their length in plaiting. Although russet leather was used in this instance, many other colors are available.

Materials needed are: 1 pc. each 4-oz. strap leather and lightweight suède 5 by 24 in. for the outside and its lining; 2 pc. each 6-oz. strap and suède 2½ by 8 in. for the sides; 4 ft. light thong for lacing; 2 pc. ½ by 30 in. for shoulder strap; 1 nickel-plated ½-in. buckle; 2 nickel-plated ⅝-in. D's for attaching straps, and 1 nickel-plated catch fastener. The cement used is either the kind with a cellulose base, known as "household," or a special leather cement.

To start construction, mark off the width of the outside piece, on a line 1 in. from one end, into twenty-six equal parts. Use a sharp knife or razor blade and cut the piece from these points to the other end into twenty-six narrow thongs, as shown in Fig. 3. The thongs are held together by the uncut 1-in. piece at one end.

Plaiting may now be started. Pair off the thongs two by two and cross each pair under one and over one in the manner shown in Fig. 4. If there is difficulty in making the thongs stay in place, use a little of the quick-drying cement. Measure each row of thongs carefully to maintain a constant width. Cement down the last row and trim it even.

The uncut piece at the starting end should be moistened with water and a suitable design or your name or initials impressed by rubbing the leather with a smooth-pointed tool (Fig. 5).

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Plaited *from* Leather Thongs

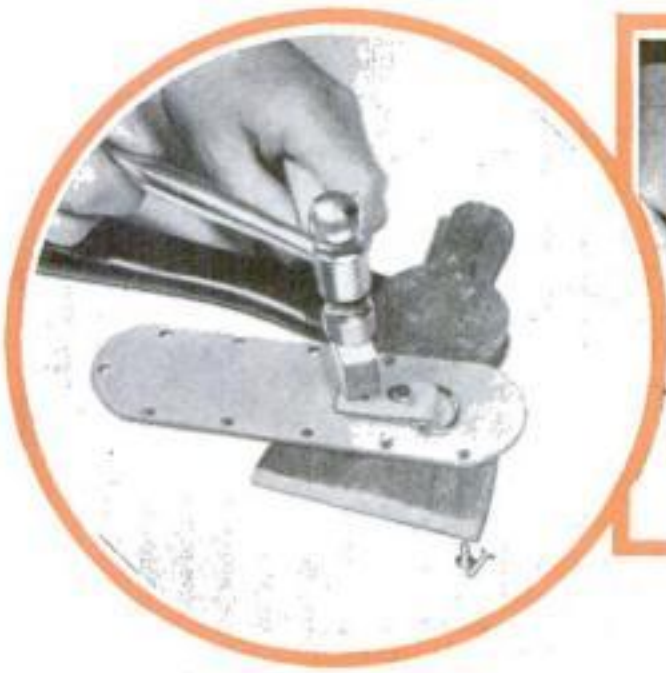

Fig. 7. The sidepieces are cut to the correct size, the corners rounded, and the lacing holes punched. Then D's are riveted on by means of short straps to receive the long plaited shoulder strap

Fig. 6. The lining suède is cemented to the plaited piece at one end as at the left. During the process of lacing the case together, more cement is applied. The lining is thus fastened little by little to the plaited piece as the work continues

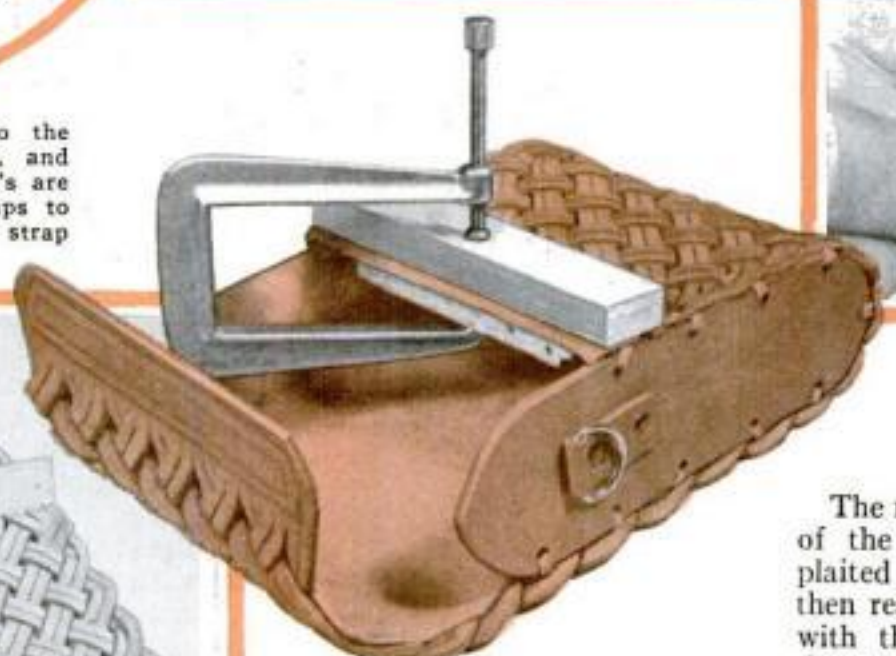

Fig. 8. How the plaited piece is laced to the sidepieces. The lacing passes around the inside thong of the outer pair nearest each hole

Fig. 9. When lacing the last hole, pass the thong through the plaited work where it will not be visible after the suède lining is folded over the ends of the plaits

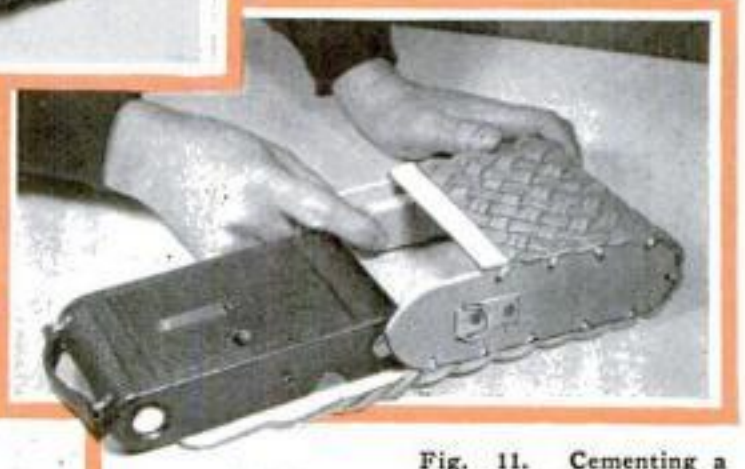

Fig. 10. To make a neat finish, it is necessary to fold a binding strip of suède over the end of the plaited work, secure it well with cement, and clamp it down to dry

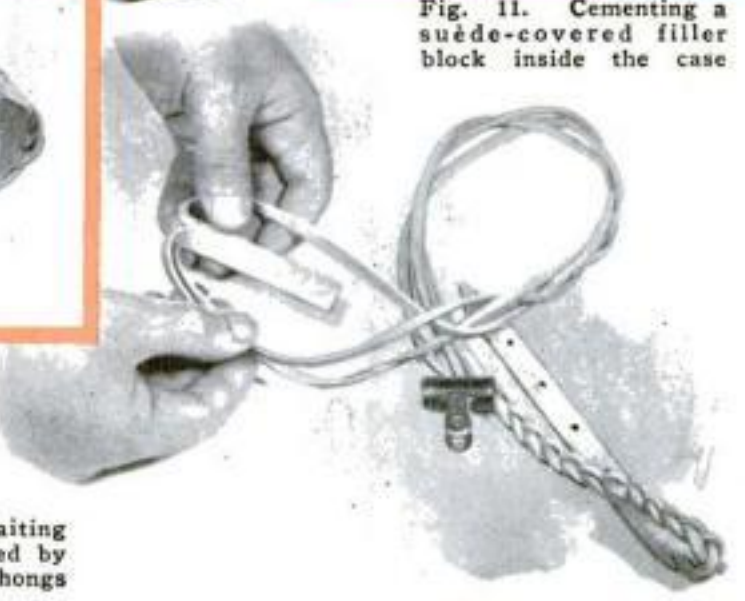

Fig. 11. Cementing a suède-covered filler block inside the case

Fig. 12. In attaching the catch, which is the last thing to do, use a pair of pliers and protect the metal with a scrap of leather

Fig. 13. The tangle caused by plaiting the shoulder strap may be removed by passing the loose end between the thongs

The next operation is to cement one end of the lining suède to the end of the plaited work as in Fig. 6, and you are then ready to start lacing. The sidepieces, with the corners rounded and trimmed down to the correct width, are punched with lacing holes 1 in. apart. Short strips of leather with the D's attached are riveted in place (Fig. 7), and the lining suède is cemented on.

One end of the lacing thong is cemented between lining and sidepiece, and the lacing is carried on as illustrated in Fig. 8. The lacing is passed around the inside thong of the outside pair nearest each hole. The lining is cemented down on the outside piece, or plaited work, as the lacing progresses; otherwise it would tend to buckle. A piece of suède is folded over and cemented down around the end of the plaiting as in Figs. 9 and 10.

It is necessary to place a suède-covered piece of wood in one side of the case (Fig. 11) to give a good fit underneath the winding key of the camera. The case is completed with the attaching of the catch fastener (Fig. 12).

An end of one of the shoulder strap pieces is pointed and punched for buckle holes. Each piece, with the exception of 3 in. at each end for riveting to the camera case and buckle, must be cut into three thongs, which are then plaited. After a few inches have been plaited, the loose thongs will become tangled, but they may be straightened by passing the free end through the thongs as in Fig. 13.

If you would like more articles to be published in the magazine on this kind of leather work or if you prefer other types of handicraft, please send your requests to the home workshop editor.

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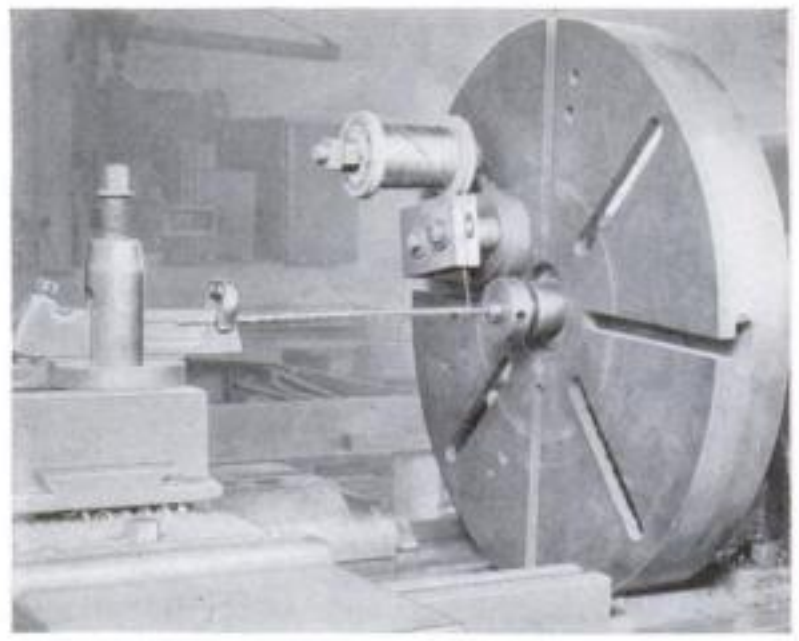
Compact hanging shelves made from old basket covers

BASKET COVERS FORM ROOMY FRUIT RACK

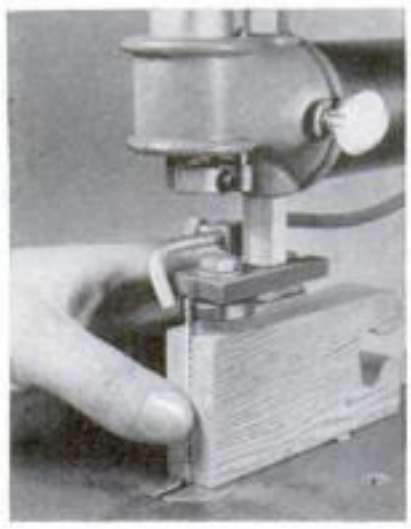
From a number of basket covers and three chains, it is possible to make a compact but roomy hanging rack on which to spread out small fruits such as oranges and pears, and vegetables such as onions. The one I have in our basement vegetable room is only 40 in. long, yet it will hold 50 lbs. of onions and much fruit.—Chester R. Echternach.

WINDING COILS OF SMALL DIAMETER



Designed originally for winding electrical coils of nickel wire, the lathe set-up illustrated is an especially simple and useful one. As the rod that forms the mandrel does not turn, coils of any length can be wound by this method.

The spool of wire is mounted on the face-plate on a long bolt fitted with two nuts to prevent binding. The wire is led off the spool between two pieces of fiber. The bolts holding this fiber in position on the faceplate can be tightened to increase, or loosened to decrease, the tension. A rod of the desired inside diameter of the coil is inserted through the headstock and clamped to the tool support. The wire is given a few turns around this rod by hand, after which the lathe may be started. With the carriage set to produce the desired number of turns per inch, a neatly wound coil results. As there is very little deflection of the rod, very small coils can be prepared.—R. C. Whitney.

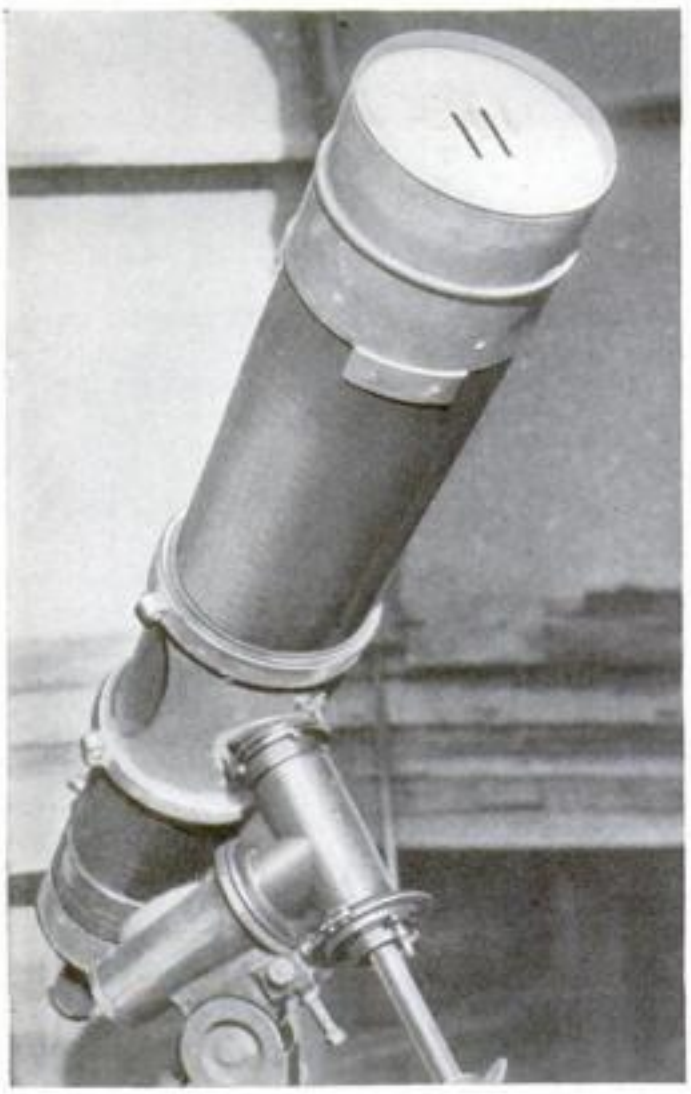


GUIDE FOR JIG-SAW BLADES

For first-class results, modern scroll saws require that the blades be inserted in an absolutely perpendicular position, or at a perfect right angle to the saw table. This is easily done as illustrated.

The block is a 1 by 1⅞ by 4 in. piece of hardwood. Insert a blade by the ordinary method, making sure that it is absolutely straight; then cut a shallow slot in the end of the block. New blades are quickly installed merely by holding them in the slot, with the block on the table, and tightening the lower clamp with the other hand. They will always be straight. It is advisable to prepare two or three of the blocks to correspond to the range of blade sizes.—George S. Greene.

HOW STAR MEASUREMENTS ARE MADE



A useful device for demonstrating the principle of the stellar interferometer for measuring stars can be made by cutting two narrow parallel slits equidistant from the center of a cardboard disk, which is then placed over the lens of the telescope. If one of the brighter stars is viewed through this arrangement, the customary small, round star-image will be replaced by a series of images in the form of a narrow band.

In actual practice, with large and accurate instruments, the light from the star is reflected into the telescope by a system of movable mirrors that can be separated by as much as fifty feet, depending upon the size and distance of the star. If the star under observation is very large, the dark bands, or interference fringes, will disappear when the mirrors are moved a sufficient distance apart. Knowing this distance, the star's diameter can be computed.

While, of course, no star diameters can be actually measured with this simple device, it illustrates the methods by which it has been possible to measure many of the stars.—L. C. Peltier.

FLOWERS NEED NO WATERING

Moisture from the air may be utilized to water this beautiful and unusual flower bowl. Small pebbles are first arranged in the bottom of the bowl—in this case a fish bowl—to form a base and reservoir for surplus water. Rich dark earth is placed on top of the pebbles, and plants that have previously been in water and have developed small roots are set in the soil. Moss is used to cover the soil around the plants; this helps retain water and beautify the display. A sufficient amount of water is poured on the moss to dampen the soil underneath, and a lid—one that fits snugly—is set over the opening.

The flower bowl will require no more watering, but every day, for a period of about two hours around noon, the lid should be removed. This allows fresh, warm air to enter. During the night the cooler air surrounding the bowl causes the moisture content of the warm air inside to condense on the inside of the glass walls, and a sufficient quantity of moisture trickles down to the soil to insure luxuriant growth.—Harry C. Brown.

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Electric Fixtures
Made from SAPLINGS
HARMONIZE WITH ANY RUSTIC SETTING

By Leonard F. Merrill

One of the wall fixtures, the bracket of which is made from a crooked piece cut from a sapling. The lights are best used in pairs as at the left

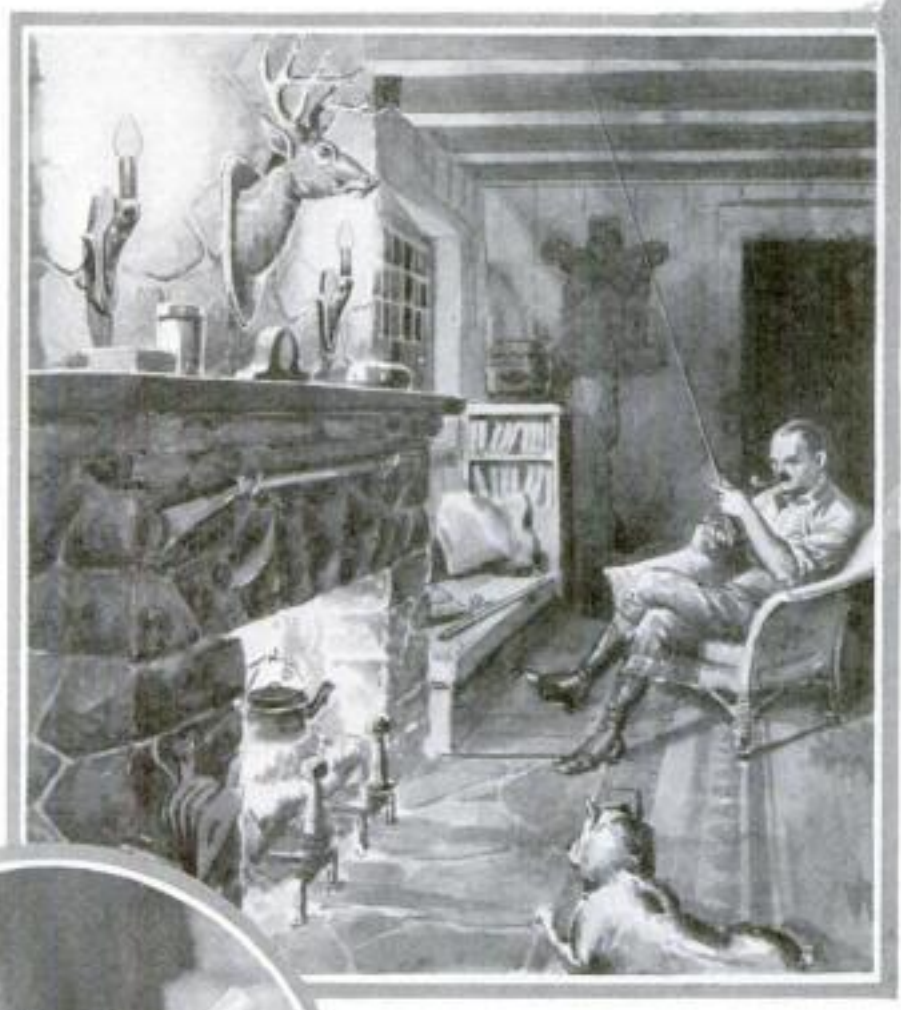
A PAIR of electric wall fixtures or sconces made from saplings are decorative additions to any rustic-finished attic or basement room or to a cabin or summer cottage.

Materials. The following may be purchased at any store carrying electrical fixtures: 2 candle converters for adapting candlesticks to hold electric candle lights; 2 candle-fixture sockets; 2 candle covers; 2 flame bulbs; 1 plug cap; and about 12 ft. of silk-covered, parallel wire lamp cord. The rustic part of the sconces must come from the woods—two saplings about 1½ in. in diameter, with a bend as shown. A shield or back plate may be used or not, as desired. If used, two boards about 6 by 10 in. will be needed.

Tools. A saw, screw driver, knife, ¼-in. bit, another bit (about ¾-in.) to make a tight-fitting hole for the converter, a brace, and a pair of pliers will be all you need.

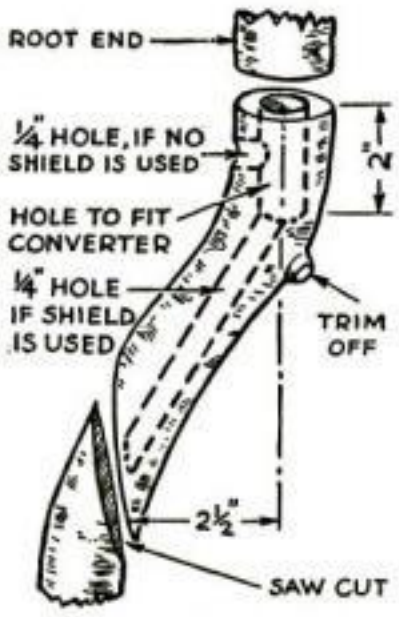
Saplings. Take a hatchet or saw and go out into the nearest woods where you find no restrictions or where you have received permission to cut two saplings. Almost any kind of wood will do if it is solid wood and not pithy at the heart. Birch, maple, beech, and hickory are all good.

Look for a sapling about 1½ in. in diameter that has a bend similar to the one shown. These bends may be found at various locations in the sapling, but one place in particular is near the base where it started to grow up straight, then for some reason changed its mind and twisted out of plumb, but later on grew up again in a vertical position. Another location for this bend is where two branches have started, but one of them has failed to flourish, the other continuing to grow very nearly as large as it was before the branching started.



The shield, if one is used, is fastened to the brackets with screws. Note the groove in which the parallel wire lamp cord goes before shield is hung

The type of bent sapling that is required, and the various fittings. The latter are sold for homemade electric candlesticks



How the sapling is cut. When a shield is used, a long ¼-in. hole must be bored; otherwise a short one will be sufficient

Construction. The lower end of the bent sapling is to be the upper end of the finished sconce, so reverse the natural position of the wood. With the sapling in the new position, saw off the top end at right angles to the vertical axis, about 2 in. above the bends. The other end is sawed at right angles to the first cut or parallel to the vertical axis. There should be about 2½ in. clearance between this second cut and the center of the first end cut. Cut the second sapling the same as the first to make a matched pair as uniform as possible.

In the center of the upright end, bore a hole that will make a tight fit for the converter and a little deeper than the converter is long.

A ¼-in. hole for the wire is now bored in each piece. If a shield is to be used, a hole will have to be bored up through the full length of the piece, intersecting the larger hole at its base. Another hole will have to be bored through the shield piece to meet the hole in the lower end of the sconce piece. Where no shield is used, the ¼-in. hole is bored from the back of the upright piece near the top, intersecting the larger hole at a point that will come opposite the small hole in the converter.

Fasten the sconce piece to the shield *(Continued on page 76)*

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HOW TO CONVERT AN OLD AUTO GENERATOR INTO A

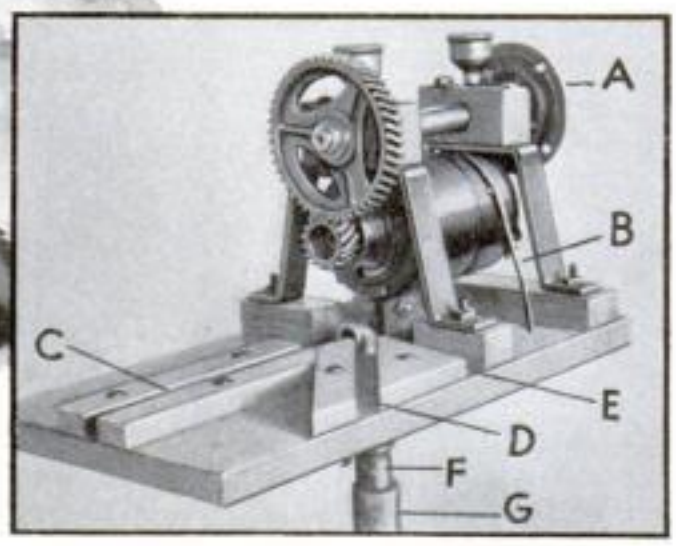
Wind-Driven Battery Charger

By L. G. HEIMPEL

Professor of Agricultural Engineering,
Macdonald College, Quebec, Canada

MANY thousands of farm folk are still dependent upon battery sets for their radio programs. To them the charging of storage batteries is still the greatest bugbear of the battery set. This homemade wind-driven charger is an economical solution of their problem; indeed, it is designed to take care of not only the battery of a single set but the batteries of a whole neighborhood. The farm boy who makes one of these in a community not served by high-line power can earn the cost of the plant and extra spending money in a short time.

The plant consists of a 6-volt automobile generator mounted on a turntable on a mast of piping as shown in the drawings. The generator is driven by a 6-ft. two-bladed wind wheel or rotor which is really a propeller of the airplane type, through a 3-to-1 ratio gear drive. This is necessary to insure correct generator speeds. The plant is designed to produce a sufficiently high voltage to close the cut-out points of the generator in a wind of 10 miles an hour, though this will depend somewhat on the condition of the generator and the perfection of the workmanship in the propeller.

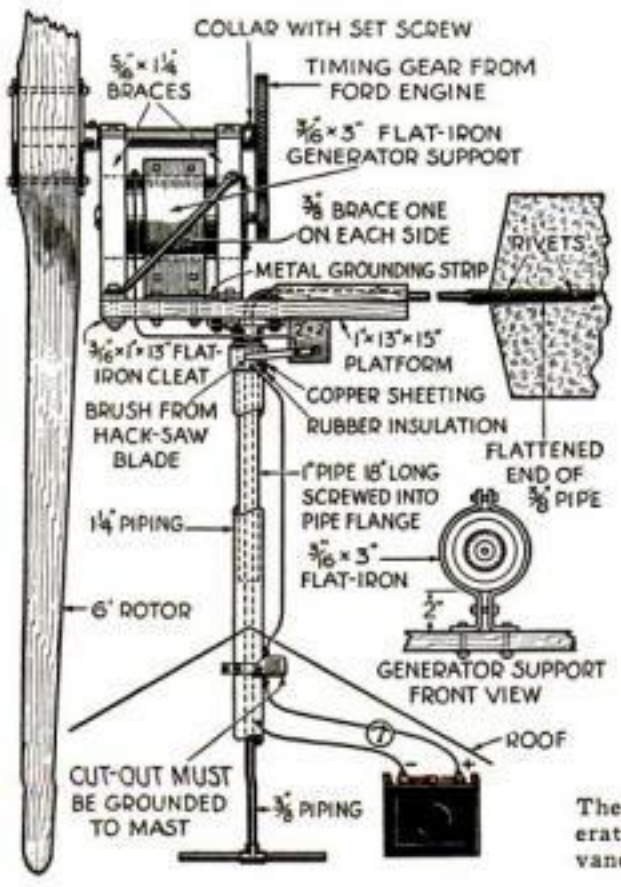


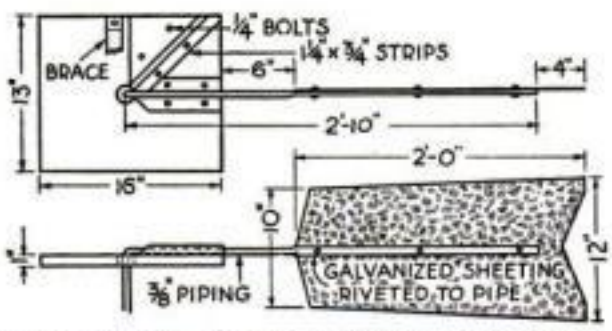
A, propeller flange; *B*, positive wire to sliding contact brush; *C*, *D*, *E*, grooves for vane bar; *F* and *G*, pipes

The generator may be one from a model-T Ford, a Chevrolet, Overland 4, or any light car made during the last ten years. It must be in good condition, and the cut-out and ammeter will be needed. The brackets or supports which hold the propeller shaft are of flat iron and can be made by any blacksmith. The bearings may be of wood, if desired, though care is necessary to make certain of good alignment in boring the holes for the shaft and in mounting the bearings on the supports, otherwise there will be too much friction. Hard maple or birch blocks are best for wooden bearings, and after they are made they should be boiled in linseed oil. A piece of 7/8-in. cold-rolled steel shafting is about right for the propeller, but other sizes will do equally well.

The generator is driven by the camshaft gear of the automobile engine, which is mounted on the propeller shaft and meshes with the regular generator drive gear on the generator shaft. The cam gear will have to be fitted to the end of the propeller shaft in a machine shop, though this is a simple operation. With a little ingenuity a sheet metal cover can be made to protect the gears and to provide an oil bath for them. However, the writer knows of several outfits which have been running dry for several months, yet the gears show little wear.

How the airplane type propeller is tested for balance. A nail is driven into the center hole on each side, and these rest on two steel squares, which serve as parallels





The general assembly drawing, a front view of the generator support, and details of vane and turntable. The vane can be set full on, full off, or half into the wind

The turntable is mounted on a 1-in. pipe flange into which is threaded a piece of 1-in. piping about 18 in. long. The inner mast is slipped into the mainmast, which consists of 1¼-in. piping. The length of this mast depends on the nature of the building *(Continued on page 76)*

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BIN ON CRIB HOLDS BABY'S TOYS

Above: The holes can be bored by hand or on a drill press if available. *Right:* The toy bin in use

IF A BABY finds toys at hand when he awakens from sleep, he will often play contentedly for some time without demanding attention from mother. A place for the toys can be provided by making an attractive bin or toy box that hooks over the bedside. Such a bin is illustrated in the circle, and the construction is shown in the drawings at the right, which also give the colors.

Three-ply wood ¼ in. thick is suitable material both for the box itself and the butterfly overlay with which the front is ornamented. Draw a full size half-pattern for the front by ruling a sheet of paper into 1-in. squares, to make easy the copying of the design. When the butterfly shape has been drawn to your satisfaction, use carbon paper to transfer the pattern to a piece of plywood 6 by 9½ in.

Both wings are shaped at the same time. Tack the first piece to two others. The bottom piece merely serves to prevent splintering the second when the cutting is being done. Saw the outlines of the wing assembly, using either a jig or a band saw, but do not follow the veins which curve across the wings until after the holes have been made.

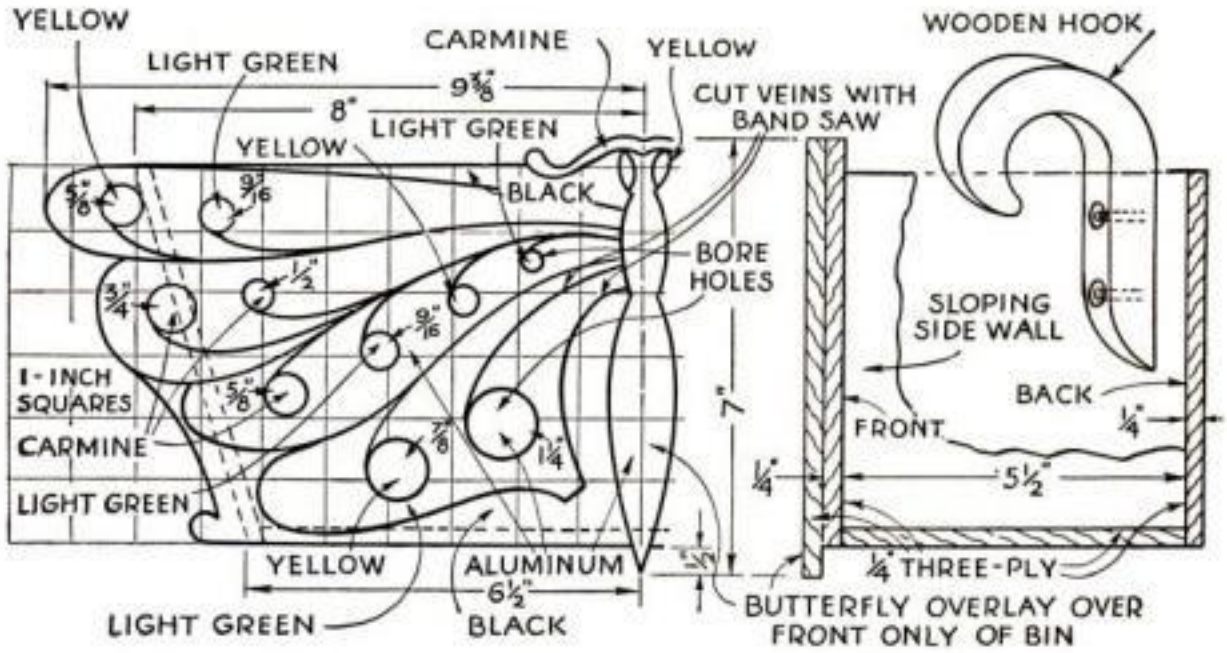
The next step in the construction is to bore the holes. The large one in the lower wing can be cut with an expansive bit, either by hand or in a drill press, as shown in the photograph at the left.

Now saw apart the four wing sections, and cut the veins leading to the holes. The body, head, and antenna are made in one piece. If a sanding belt is available for the band saw, or a sanding attachment can be applied to the scroll saw, smooth the outer edges of the wings mechanically; otherwise, rub them smooth by hand.

The front and back of the bin proper are alike except that the front takes the curve of the antenna, while the back is straight. Cut the ends of the sidepieces and of the bottom to an angle of 1½ in. in 6 in. Nail these parts together; then scribe guide lines on the inside faces of the front and back, and brad them on. Assemble the butterfly on the front with glue and brads, puttying the holes with wood composition.

Paint black all the exposed edges and also that part of the front appearing as a background. The upper wings are aluminum, the lower light green, these colors being applied after the spots have been painted as indicated in the drawing.

Attach spring-wire hooks protected with rubber tubing, or wooden hooks, to the back of the bin for hooking it quickly and securely to the crib.—EDWIN M. LOVE.



BRUSH FOR STENCILING

SMALL stencil brushes are expensive and often there is none on hand for an emergency job of stenciling. A substitute can be made, however, from a cheap shoe blacking brush from which the long handle has been removed. A new handle is made from a large cork as shown above. A fairly long wood screw is run through the cork and into the wooden center of the blacking brush ferrule.—F. B.

SIPHONING AN AQUARIUM

HOWEVER much you may enjoy cooked fish served at meals, it's a sure thing you haven't any liking for the fishy water of an aquarium as a beverage. Yet the common method of starting a siphon—sucking on the end of the tube—is almost sure to fill your mouth with aquarium water unless you do the trick as illustrated at the right.

First, insert the end of the tube in the water and drape the tube over the side of the aquarium to form a loop. Your mouth should be from 18 to 24 in. above the level of the water. Then give a short, quick suck on the tube by moving your tongue backward just as you would draw on a cigarette or pipe. This causes the water to flow up and over the bend and fill the pipe up to the level in the aquarium. Now quickly remove the end of the tube from your mouth and lower it into the waiting bucket.—A. P. L.

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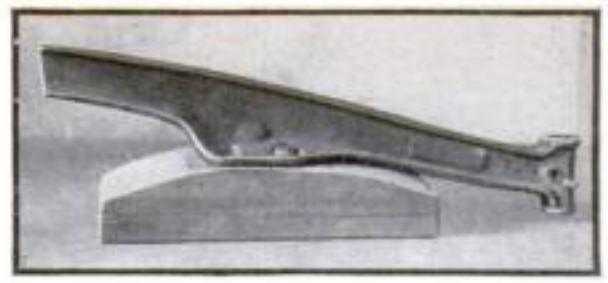
MODERNISTIC METAL DOLL FURNITURE

Children see so much modernistic furniture in the movies that they like to play with pieces of up-to-date design. These can be made without difficulty from tin and wire

STURDY and attractive modernistic doll furniture can be made from nothing more than wire and tin sheets cut from ordinary tin cans. Soft galvanized weaving wire of No. 14 gage is the best size as it may be readily bent with pliers and the fingers. In the table set illustrated, the table is 5 in. in diameter and 2½ in. high, the chairs are 3½ in. high and 1½ in. wide, and the parasol is 7 in. in diameter. No solder is necessary in the construction; the tin is merely bent around the wire as tightly as possible. A rounded edge is provided for the parasol by bending under a margin of the circumference in twelve equal divisions.

If the home craftsman cares to use solder, he can duplicate any bizarre modern furniture creations such as tea tables, chairs, and studio couches. A little polishing with steel wool gives a gleaming, silvery finish to the wire, and the tin may be painted as desired.—RAYMOND LOHR.

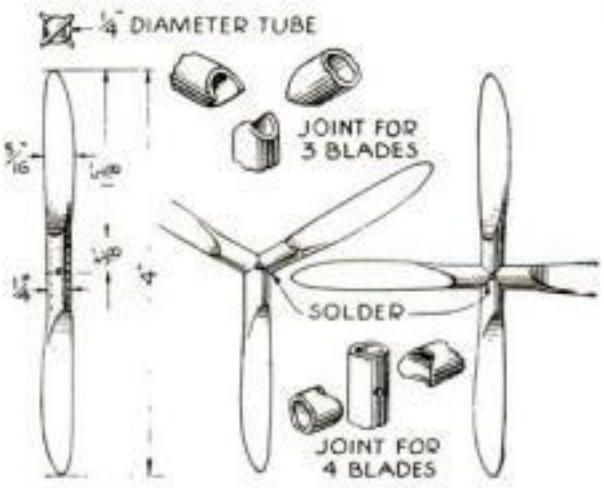


LIGHT ANVIL MADE FROM JUNKED FRONT AXLE

A SHORT section of the front axle from a junked car makes a good substitute for a light anvil. The axle should be from a car that was equipped with semi-elliptic springs. Cut off a section of any desired length with a hack saw, grind the sharp edge off the end, and also grind the top smooth. It should then be bolted to a heavy block of wood. If it is an axle like the one shown, the outer end should be left on, so the hole can be used when driving out rivets. This is an additional convenience.—LER. V. T.

TAKING CLEAR PHOTOS OF BLUEPRINTS

RECENTLY it was necessary to photograph some blueprints, but I had no suitable filter to absorb the blue light. I merely put a photoflood bulb inside my darkroom lamp with a red glass in place and photographed with this red light. Supersensitive panchromatic film was used, and the lamp was placed about 2 ft. from the blueprint. An exposure of 20 seconds with stop F/8 was given.—S. T.



TUBING USED FOR MODEL PLANE PROPELLERS

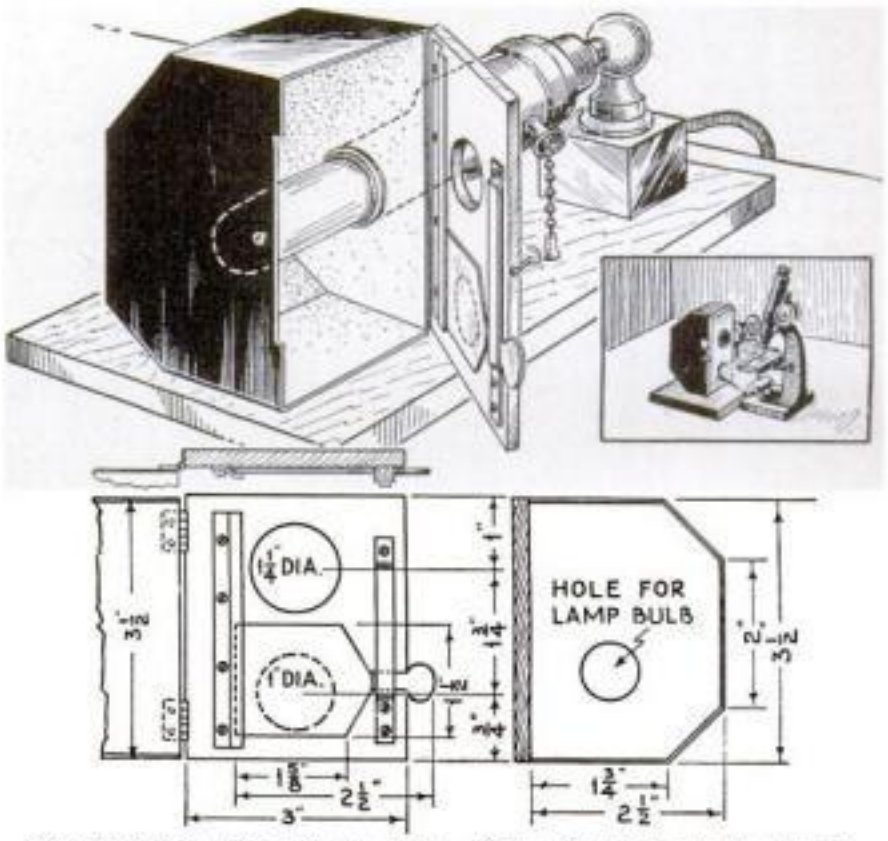
REALISTIC propellers for model airplanes of the type described in Donald W. Clark's series of articles can be made from copper tubing. I use ¼-in. tubing for 4-in. propellers; for other sizes, larger or smaller tubing should be chosen.

Cut the tubing the right length, find the center, and mark off a space for the hub—about ⅜ in. each side of the center is satisfactory for a 4-in. propeller. From this point to the end, squeeze each blade flat in the vise, taking care that the blades are in the correct relation to each other. To give a better appearance, apply solder where the edges of the flattened tubing come together. Then file the propeller to its final shape and drill a hole through the hub.

Both three-bladed and four-bladed propellers can be made by first preparing two single blades, then cutting and joining them.—HOWARD D. THOMPSON.

A QUICK-CHANGE MICROSCOPE LAMP

THIS adjustable microscope light will throw its rays either above the object being examined or onto the mirror below the object. It is merely a small box inclosing a miniature electric bulb. There are two apertures in the front, either of which can be closed by sliding a tin shutter up or down, as the case may be. This plate has a projecting handle so that it is unnecessary to open the door when making adjustments, and it slides behind tin retaining strips that are screwed to the rear side of the door.



The lamp-box door has two holes, either of which can be closed by means of the sliding tin shutter. In this way the beam of light can be shifted instantly from below to above, or vice versa

The dimensions given are for a small microscope of a type frequently used by amateurs, but they can be modified to suit an instrument of any size or design, and the box may be constructed of any desired material.

In the original model, the light reflector was made from a grade of tin that has a high luster, and the joints were soldered. In another model made later, I found it necessary to ventilate the compartment, as the heat became so great that the lamp burned out. This was, however, a somewhat smaller model. In any event, ventilation may easily be provided.

We find this arrangement has nearly doubled the pleasure my daughter and I have received from our microscope, as two views can be seen of almost everything examined.—WALTER K. MOSS.

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WHEN ONE SPARK PLUG ENJOYS GREATER DEMAND THAN ALL OTHER MAKES COMBINED—IT *HAS* TO BE A BETTER SPARK PLUG!

You know that there is always a reason for *popularity* . . . for *leadership* . . . among men or among manufactured products.

Then ask yourself why more AC spark plugs are used by car builders today than all other makes of plugs combined. Why 7 out of every 10 new cars and trucks are AC-equipped. Why ACs win far greater favor month after month than all other makes of plugs combined.

The answer is ACs are *better* spark plugs—better because of these five *patented* features: (1) one-piece heat-sealed construction; (2) exclusive AC insulator combining great heat-resisting qualities with mechanical strength; (3) welded side-electrode; (4) unglazed insulator tip; (5) Isovolt electrodes. These are technical features, of course—but vitally important. Your dealer will explain how much they contribute to better engine performance.

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It pays to install new spark plugs every 10,000 miles —because worn plugs waste one gallon of gasoline in every ten, and waste power and performance, too.

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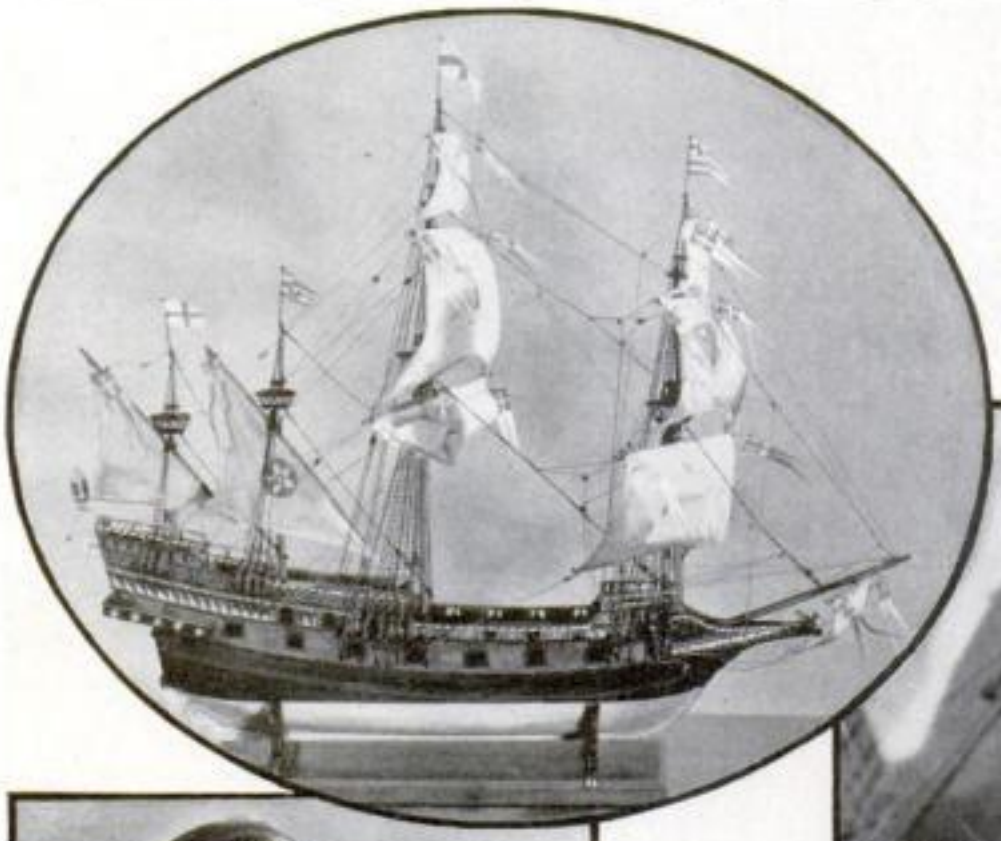
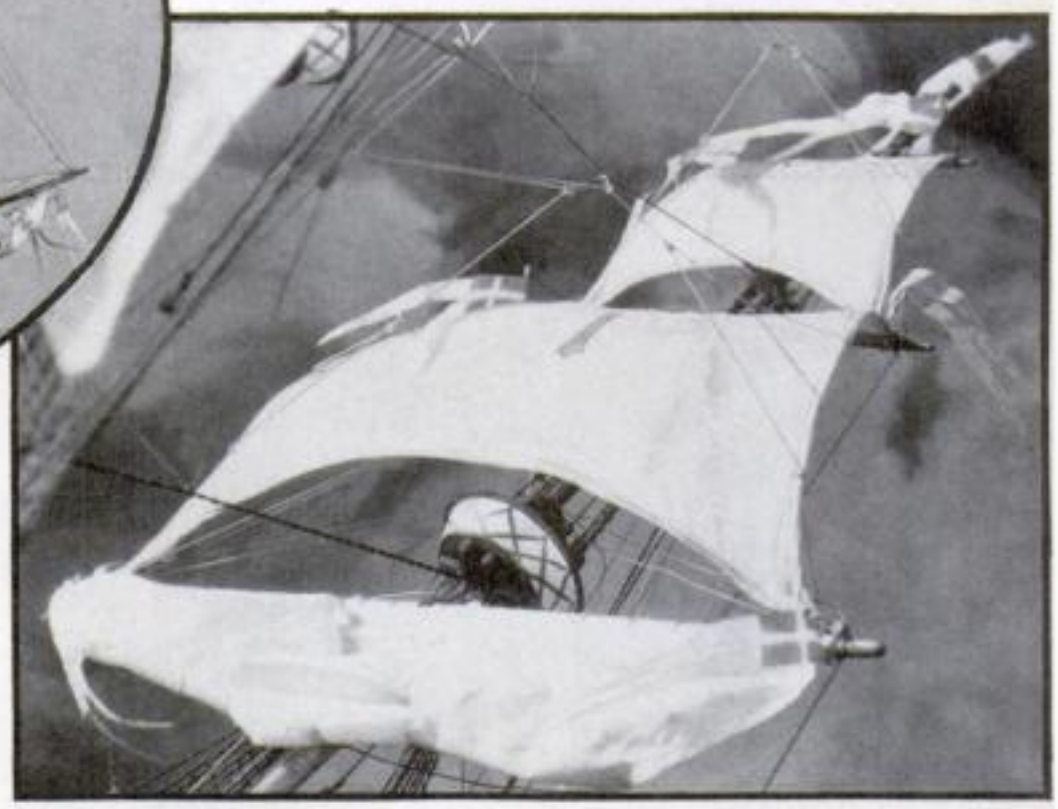
The "*REVENGE*" Spreads Her CANVAS

Capt. E. Armitage McCann *tells how to put all the finishing touches on our new Elizabethan galleon model*





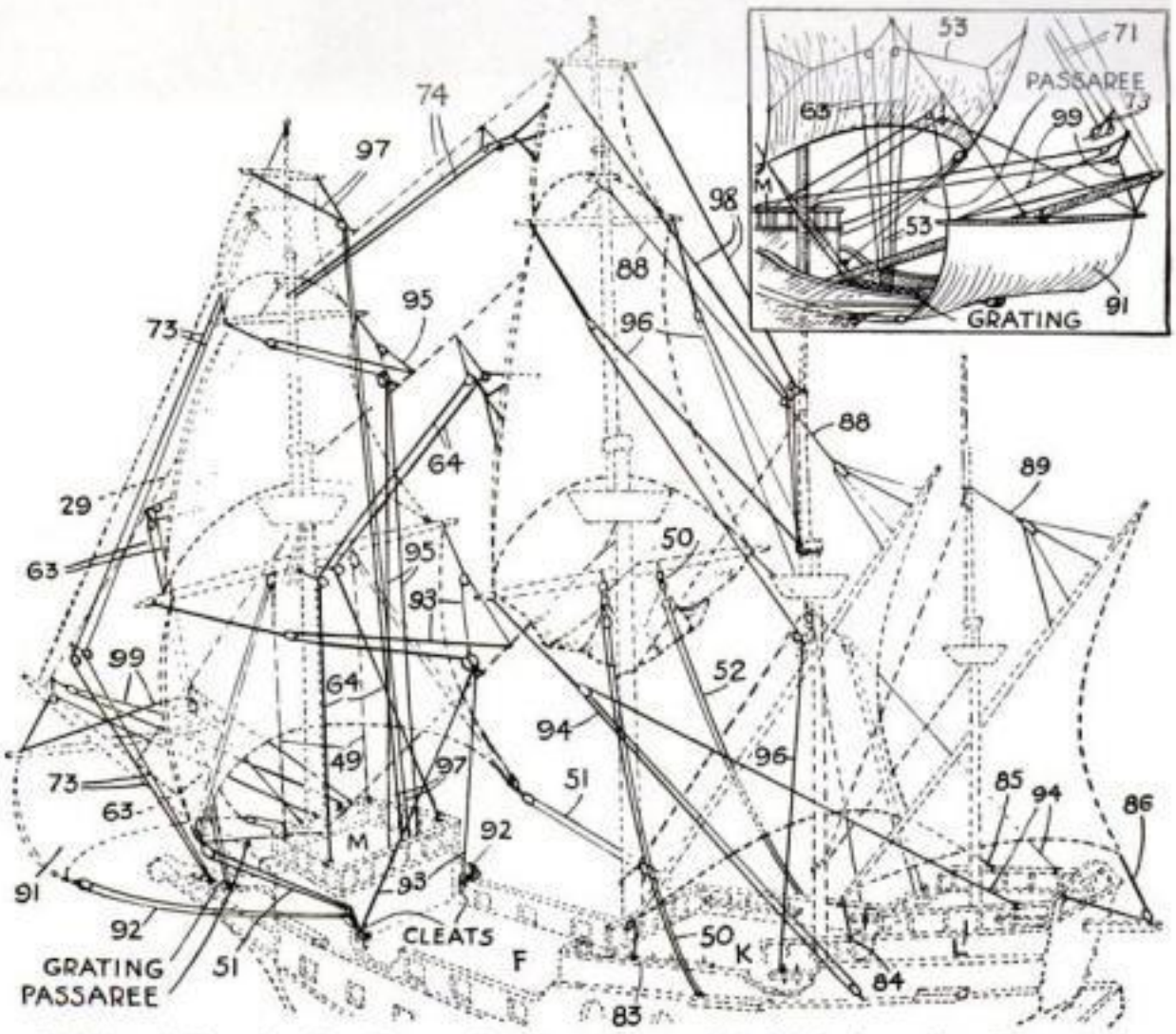
Above: Finished model. *Right:* Looking aloft—the mainmast. *Left:* The author adds the flags

IN BUILDING our new Elizabethan galleon model, the *Revenge*, it should next be decided how the yards are going to be placed with regard to the hull. You can have them square across as if the wind were right aft, braced up for the wind ahead, or slightly braced up as for the wind on the quarter. The latter is the style I adopted, with the wind as if on the port side.

On the foresail, run a loose, double sheet *51* on the weather side (the near side of the large rigging drawing at the right) to the cleat inside the bulwark, and a passaree of single *a* size cord down to the stay, fairly tight; then tighten the clew line *49*. A passaree is a rope for extending the clews of a square sail when before the wind. On the lee side run the sheet to a main rigging chain or channel and leave the clew line slack. If the mainsail is clewed up, haul up the clew lines *50* and buntlines tight and leave the sail hanging in them.

The halyards *65* and *66* of the topsail yards (shown in the separate halyard drawing on page 84) are rove through the holes in the masts and hitched to the yards like the fore and main halyards. Then double blocks are seized in the ends about 5 in. from the deck, single blocks are tied to the staples in the decks, and tackles are rove off and belayed to the handrail at the fore and a belaying pin at the main. The tackles should finish at the lower blocks and be brought upward to the belaying point.

For topsail sheets (*67* and *68* on the main rigging plan previously published) I merely hitched lines to the clews and to the yardarms. *(Continued on page 84)*



Full lines indicate bowlines, braces, clew lines, sheets, and their belaying points. Insert shows belaying of fore, fore-topsail, and fore-topgallant bowlines, spritsail lifts, braces, and passaree

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TODAY'S FEATURE
AL *and* **MAY-**
Mind Reading Act

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—IT'S MORE FUN TO KNOW

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FREE—*SEND NO MONEY*—**FREE**

36-PAGE ILLUSTRATED MAGIC BOOK CONTAINING 23 MYSTIFYING CIGARETTE, CARD, AND COIN TRICKS. YOU CAN FOOL THOSE "WISE GUYS" THAT KNOW IT ALL, WITHOUT SKILL OR PREVIOUS EXPERIENCE. MAIL ORDER BLANK AT RIGHT WITH FRONTS FROM FIVE PACKS OF CAMELS.

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NOW WHO ELSE WANTS BLOW-OUT PROTECTION FREE!

Amazing new invention eliminates the cause of blow-outs

IF YOU were offered a tire that is saving thousands of lives . . . and preventing thousands of those blow-out accidents that maim and cripple people . . . wouldn't you be interested? And if that tire didn't cost you a penny more than standard tires . . . wouldn't you want it on *your* car right now? Then read these facts about this amazing invention . . . this invention that makes the "safest tire ever built" 3 times safer from blow-outs at high speeds.

What causes blow-outs

Today's high speeds—40, 50, 60 and 70—generate terrific heat inside your tires. Rubber and fabric begin to separate. A blister forms . . . and GROWS . . . Like an insidious tumor, it gets bigger . . . until BANG! A blow-out. And a terrible drag starts pulling your car off the highway.

But now Goodrich has perfected the amazing Life-Saver Golden Ply. This invention resists the most intense heat. Rubber and fabric don't separate. Thus blisters don't form inside the tire. Blow-outs are prevented *before they even start!* At gruelling speeds on the world's fastest track the new Goodrich Safety Silvertown Tire, with the Life-Saver Golden Ply, *lasted 3 times as long* as first quality tires that did not have this feature. These Silvertowns *never* blew. They wore right down to the fabric. But the Life-Saver Golden Ply refused to give.

Safest non-skid tread

That's not all! Scientific tests with leading makes of tires *prove* that the Goodrich Silvertown has the most skid-resisting tread. Its squeegee drying action gives your car *extra* road-grip, reduces danger of skidding to a minimum.

Remember, this "3 times safer tire" costs not a penny more than standard tires. So why take chances? That blister—that blow-out in the making—may be in *your* tire right now. Look up your Goodrich dealer in the Classified Telephone Directory. Have him put a set of Silvertowns on your car. BE SAFE!

FREE! Handsome emblem with red crystal reflector to protect you if your tail light goes out. Go to your Goodrich dealer, join Silvertown Safety League, and receive one FREE. Or send 10¢ (to cover packing and mailing) to Dept. 157, The B. F. Goodrich Rubber Co., Akron, O.

Goodrich *Safety* Silvertown

WITH LIFE-SAVER GOLDEN PLY

Copyright, 1933, The B. F. Goodrich Rubber Co.

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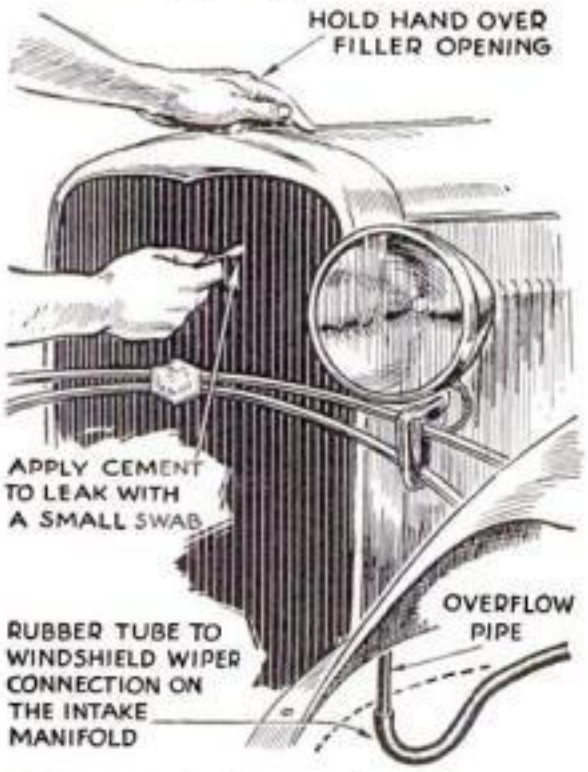
Hints *that will* Help Your Car

Tested Suggestions from Our Readers That Are Sure to Prove of Value to All Who Like to Work on Their Own Autos

An ordinary jack can be used, as illustrated, to spread the rim of a heavy tire. The base of the jack is placed against a block of wood and the rim closed for locking

WHEN you have trouble spreading a stubborn rim on a heavy tire, you can call on your regular jack to do the job. Place a 1 ft. long "two by four" or similar block of wood across the inside of the rim opposite the split joint. Then, set the base of your tire jack on the block so its upper end bears against the inner lap of the joint. Operating the jack to raise the head will spread the rim and push the stubborn lap into place.—J. B., Jr.

Stopping a Leak



SMALL leaks in a car's radiator sometimes can be stopped with shellac or a waterproof cement. However, these leaks are generally on the side or bottom of a cell or tube where gravity will not carry the mending liquid into the opening. To overcome this difficulty, the writer connects one end of a length of rubber tube to the windshield wiper connection on the manifold and the other end to the overflow pipe on the radiator. By idling the motor, the manifold suction is used to draw the cement up into place. When a motor is idling, however, the manifold vacuum is likely to be severe so the radiator cap is removed and one hand is placed over the filler opening. By lifting and replacing the hand, the suction in the radiator can be controlled quickly. The cement is applied with a small swab held in the other hand.—E. T. G.

Windshield Can't Rattle

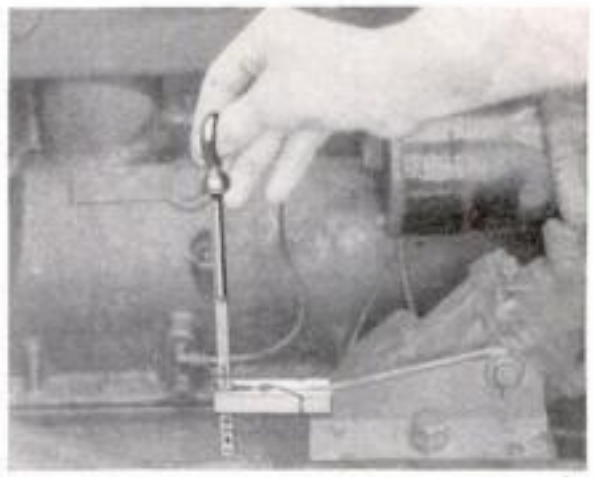
NOISES in an open car caused by a loose windshield can be cured with the simple anti-rattle clips shown. Two 2½-in. lengths of stiff wire are covered with flexible rubber tubing of the windshield wiper connection type and bent U-shape to fit the windshield frame. One clip is placed over the metal frame at each side of the windshield. Although the dimensions given are for a small car, sizes vary only slightly for larger models.—R. F.

U-shaped pieces of wire, covered with rubber, can be used to stop the rattle of windshield

Two Keys in One

IF TWO keys are required for your closed car, you can simplify matters by combining them. Cut off one-third of each key head, bevel them for about 3/16-in., and solder them together as shown. Then, so the keys can be identified easily in the dark, file off the shoulders on the door key.—H. W. S.

Two keys cut and soldered together to make one key

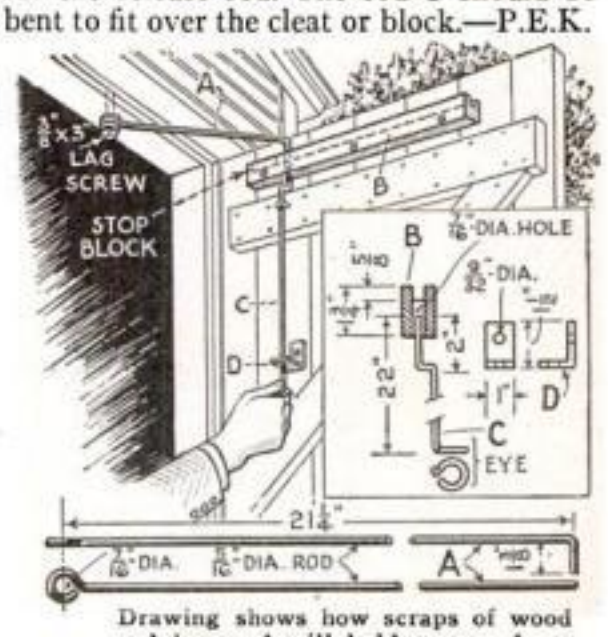


Oil Gage Wiper

A WIPER for the oil gage rod on your car can be made by gluing pieces of thin felt to the inner sides of the ends of a spring clothespin. The wiper then can be placed close to the oil gage rod hole by clamping its jaws on any convenient edge of metal.—L. G. P.

Stops That Will Hold Your Garage Doors Open

STRONG, professional-looking stops for swinging garage doors can be made from scrap pieces of wood and about 8 ft. of iron rod. The materials purchased new should not cost more than fifty cents. The sliding arm, guide rail, and release rod are assembled as shown in the drawing. As the door is opened, the arm A swings out as its free end follows along the groove in guide rail B. When it reaches the stop block at the inner end of the groove, it slips into a hole and is held fast. To close the door, the release rod C is pushed up. This raises the end of arm A out of the hole and allows it to slide forward. By placing the guide rail hole 1 ft. from the inner edge of the door and the pivot point of arm A 1 ft. from the door jamb, the door will be held in a position a little more than wide open. If the door has no cleat located below the guide rail a ⅞ by 2 by 2-in. block can be screwed to the door to serve as a stop for the release rod. The rod C should be bent to fit over the cleat or block.—P.E.K.



Drawing shows how scraps of wood and iron rod will hold garage doors

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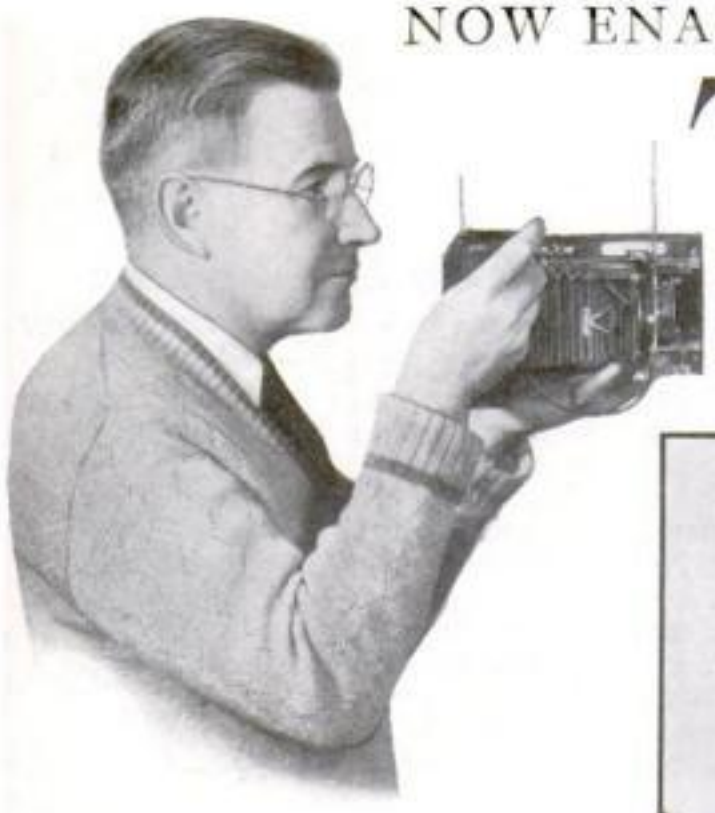
Supersensitive Films

NOW ENABLE THE AMATEUR TO TAKE

True-Tone Photos



The new films are so fast that snapshots can be taken even when yellow filters are used

Here is an example of the fidelity with which panchromatic film gives the correct tone value to each color. Note how the white band across the light blue cap stands out and that the deep red ribbon appears to be dark gray instead of black, as it would with films of the usual type

By Frederick D. Ryder, Jr.

"WHAT do you think of that picture?" asked a friend of mine, an expert professional photographer, as he slapped an 8 by 10 in. cloth-backed print on his studio counter in front of me.

The view showed a recently completed private home. All the details were brought out most realistically, and the point of view had been skillfully chosen to show the house to best advantage.

"Seems an excellent job to me," I said. "I see you used panchromatic film."

"The customer doesn't think so," he growled. "He complains that the sky is all gray. He says the sky in all the photographs he has seen is white and he wants to know why I didn't get a white sky, too!"

The idea that the sky should be represented in a photograph by so much blank white paper is just one of many popular errors. They have been fostered by the limitations of the photographic materials amateur photographers have been using since a roll-film camera became a standard part of the vacationist's equipment.

Blank paper skies, foliage too dark, red roses looking like lumps of coal, light-colored, shellacked woods coming out in the picture like mahogany and mahogany like so much pitch, blue eyes many shades too light, brown eyes like pools of ink, rouged lips as though they were smeared with lampblack, straw blondes turned into brunettes, and worst of all, ten or twenty years added to everyone's complexion—these have been some of the errors we have accepted as normal to amateur photography.

The trouble has been, of course, that the film we have used doesn't see colors as does the human eye. Now, with the new supersensitive panchromatic roll film and film packs, we can expect nearly all colors to reproduce in our pictures in shades of gray much more nearly approximating the tone values that the human eye actually sees.

Every amateur photographer knows that the complexion of a baby or small child photographs well. The light reflected from the skin of grown-ups, however, often contains uneven amounts of red and yellow. Ordinary film is not especially sensitive to yellow light and hardly sensitive at all to red. On the grown-up's face there may be a tiny spot or small area a little redder than the rest of the skin on the face. To the eye, which sees red so well, the spot is hardly noticeable, but to ordinary film the spot is darkened and much magnified. This is especially true of freckles. Faint ones hardly visible to the eye stand out as disfiguring blotches in a photograph taken with ordinary film. If you use the new supersensitive panchromatic film with its marvelous sensitiveness to yellow and red light, the freckles will appear no more prominently in the picture than they do on the face of the real subject.

One thing you can bank on, and that is the new film will produce in monochrome or shades of gray approximately what you see with your eyes. This goes for make-up also. Where formerly you had to guard against rouge or lip stick because the effect was about the same as smearing with soot, now, with fast panchromatic films, you can let your eyes be *(Continued on page 77)*

High lights in the new PANCHROMATIC PHOTOGRAPHY

1 Do not expect skies to appear absolutely white unless covered with white clouds. The light blue of the sky should photograph light gray.

2 Calculate indoor portrait lighting as follows: One photoflood bulb, one yard away, one quarter second at F/11. Two bulbs, half the time. Two yards, one bulb, one second; two bulbs, one half second.

3 Forget the old rules about rouge and lip stick. Let your eye be your guide. What looks right to you will register right on supersensitive "pan" film.

4 Load your camera in subdued light and keep black tape over the window at all times except when you are winding film, and then don't let the sun strike the window.

5 Make sure your photofinisher is equipped to handle panchromatic film.

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FILTERED LIGHT Gives Unusual Effects with New "PAN" FILM

1

4

2

5

3

Five different renderings of the same subject—a toy truck with yellow wheels, orange box, red cab and hood. No. 1 made with ordinary "color blind" film, the others with Super Sensitive Panchromatic Film using (2) a K-1 filter, (3) a K-2, (4) an X-1, (5) an A filter. Note how color brightnesses have been progressively reversed. Right: Color filter being placed on a Kodak Recomar.

Kodak Reçomar with Color Filter

Are you acquainted with modern color filter magic? Your camera can now make colors appear any tone of gray—from light to dark—just as the eye sees them, or purposely varied to bring up the beauty of cloudy sky, to reveal a distant mountain range, or to emphasize any given part of the subject. Kodak Super Sensitive Panchromatic Film has the necessary sensitivity to all colors. Wratten color filters in many degrees of yellow, green, blue, and red give you wide control over color rendering, as is suggested by the few examples at the left. Ask your Kodak dealer or write for a list of filters.

KODAK S. S. "PAN" FILM
Now in ROLLS and FILM PACKS to Fit Your Camera

Kodak Super Sensitive Panchromatic Film is so fast and so sensitive to all colors that it can give you filtered light pictures at snapshot speed. It gives improved tones even without filters, and is exceptionally fast under artificial light. Try it. Dealers can supply it in rolls or packs to fit your camera.

VACATION MOVIES FOR 10 CENTS A SHOT

Expense? You can forget it with Ciné-Kodak Eight. This sturdy, compact home movie camera makes 20 to 30 scenes of average newsreel length on a $2.25 film—less than 10c a shot for your finished pictures. It gives you a permanent record of the trips—the fun—the places you have seen—the folks back home—all in clear, life-like movies. There's no reason now why you can't enjoy the thrill of making movies on your vacations—it costs hardly more than snapshots. Ciné-Kodak Eight is only $29.50. Ask your Ciné-Kodak dealer to show you the excellent pictures it makes. You can get results equally good from the start.

BIG PRINTS FROM LITTLE NEGATIVES

Enlarging is as easy as contact printing with the new Kodak Auto-Focus Enlarger, Model B. Merely slide the camera up or down until the picture is the size you want. An ingenious cam-and-lever device automatically keeps the image critically sharp. This enlarger uses an inexpensive Mazda Photoflood lamp. It has dim-bright switches giving two degrees of light intensity, suited to papers of different speeds. Takes negatives up to 4 x 6—enlarges them from 1 ½ to 3 ½ diameters. Complete, with Kodak Anastigmat lens, metal paper holder, and a set of seven metal masks, $40.

Kodak Pupille, complete with range finder, two color filters and leather carrying case, $75.

If it isn't an Eastman, it isn't a Kodak

A MASTER CAMERA
No Larger Than Your Hand

A mere handful in size, Kodak Pupille offers its fortunate owner a range of photographic achievement that most camera owners can only envy. Its *f*.2 anastigmat lens and eight-speed Compur shutter enable you to take snapshots almost anywhere—indoors or out. This finest of miniature cameras is fully described in the catalog which the coupon will bring you.

Uses New Fine Grain Film

Now a new Eastman achievement, Kodak Panatomic Film, puts the Pupille in the big picture class. With a grain of exceeding fineness, it permits enlargements of generous size from Pupille negatives, crisp in detail and free from displeasing granular mottle. Kodak Panatomic Film has the speed you need, plus color sensitivity, plus fine grain.

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Showing the new, fast Kodaks, home movie equipment, enlargers, developing outfits, film, and accessories. Every photo fan should have these two booklets. Send for your copies today.

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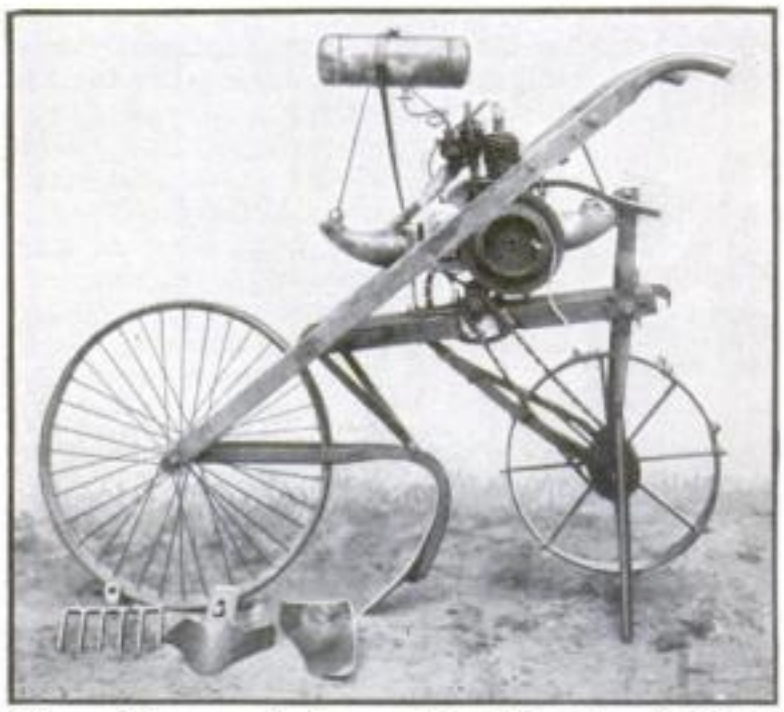
CASH PRIZES

Offered for Home-Built

Garden Tractors

IF YOU cultivate a fairly large vegetable garden, you must often wish that you owned a garden tractor. It would save so much back-breaking work. The chances are, however, that you hesitate to buy a tractor because it is relatively expensive in comparison to the value of the crops you raise in any one year. But why not build your own tractor by using an old motorcycle engine or other small second-hand engine?

It is astonishing how cheaply this can be done. The tractor illustrated, for example, was built by Joseph E. Edwards, a jeweler and watchmaker of Jackson, Ga., for about $5.



Powered by an engine from a discarded motor wheel, this garden tractor cost only $5, yet gives excellent service

Other readers, no doubt, have done the same thing successfully, and they could help a great many amateur gardeners by passing on the results of their experience. To encourage them to do so, POPULAR SCIENCE MONTHLY offers the following prizes for the best and simplest plans for a home-built garden tractor:

First Prize	$25
Second Prize	15
Third Prize	10
Total	$50

Each entry should include at least two photographs of the tractor, any necessary drawings, and a written description. State clearly the advantages of your design, what type of engine and other parts you used, how much they cost, and how you assembled them. Make your drawings as accurately as possible, but it is not necessary to ink them or letter them neatly.

To allow ample time for any readers who have been planning to build a tractor but have not yet started it, the closing date will be October 20, 1933. Entries should be addressed to the Tractor Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y. The judges will be the automobile and home workshop editors of POPULAR SCIENCE MONTHLY, and their decisions will be final. In the case of ties, each tying contestant will be awarded the prize tied for. The contest is open to all except employees of POPULAR SCIENCE MONTHLY and their families.

Entries will be judged in respect to the following points:

1. The general efficiency of the design. A tractor should be sturdy, easy to handle, and well balanced.

2. Simplicity of construction. This is important because many readers are limited in their shop facilities.

3. Low cost. The question of expense, however, is a relative one and will be considered in connection with the size and general efficiency of the tractor. It is not expected that contestants build a tractor for $5.

4. Economy in fuel and oil consumption.

Ordinarily a motorcycle engine is the best to use, but Mr. Edwards utilized the engine from an old motor wheel. Small as it is, this engine has given good service for about five years. A detailed description of his tractor will be sent to any reader who is interested, provided the request is accompanied by a self - addressed, stamped envelope.

The right side of the same tractor. You can obtain a detailed description free by sending a self-addressed, stamped envelope

ELECTRIC FIXTURES FROM SAPLINGS

(Continued from page 67)

with two screws, being careful not to drive them through the holes bored for the wires.

Wiring. Thread the wire through the holes in the sconce and then through the converter. Force the converter into place in the sconce. Screw the socket into place on the converter and attach the ends of the wire. Place the insulator on and slip the candle cover in place.

Measure the space between the points where you plan to have the sconces and cut the wire about 1 ft. longer than this. It may be possible to hide the wire behind a molding, mantel, or some other part of the room construction. This should be decided before cutting the wire so as to allow for it in measuring. Wire the second sconce as you did the first with the exception of cutting the wire.

Fasten the finished fixtures to the wall with screws. Splice the wire from the first sconce to the wire from the second, and insulate the joints with both rubber and friction tape.

Attach the plug cap to the end of the wire, screw the bulbs into place, and plug into the nearest outlet.

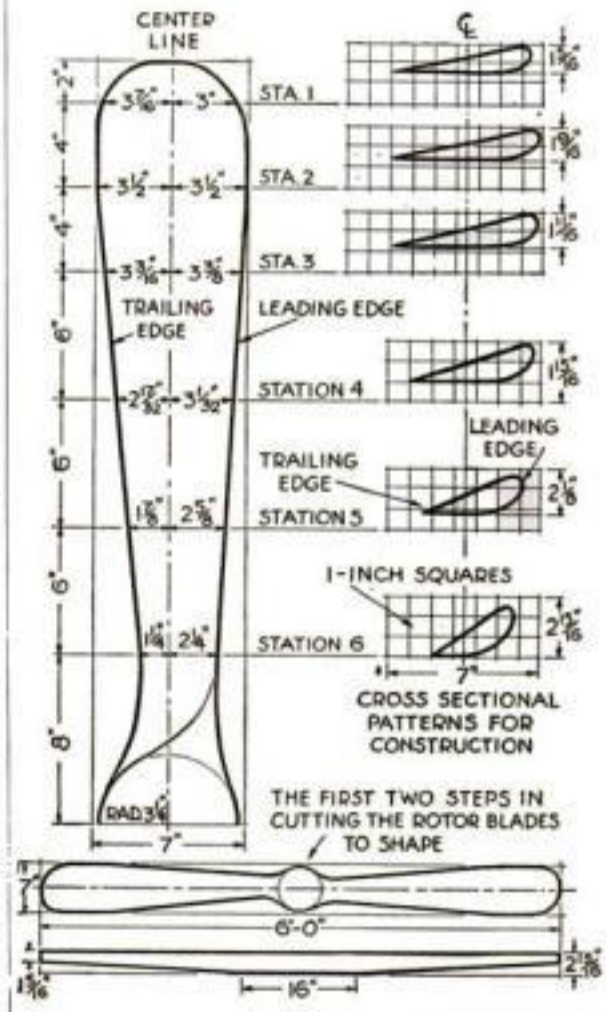
MAKING A WIND-DRIVEN BATTERY CHARGER

(Continued from page 68)

or derrick on which the outfit is to be mounted, but the design shown may be used under almost any conditions.

The requirements, of course, will vary somewhat with the circumstances under which the plant must operate. There may be some differences between the generator employed, for example, and that used in the plant described, which is from a model-T Ford. The distance between the generator and the battery should never be more than 50 ft.

A long bulletin with detailed instructions for making the propeller and assembling, wiring, and operating the plant will be sent free to any reader who incloses a large self-addressed and stamped envelope.



How the blades are marked out and shaped. The flat surfaces face forward into the wind

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Fast New Films Give True-Tone Photos

(Continued from page 74)

your guide. They will not deceive you.

If you are photographing a young woman, for example, and her cheeks look pale and her lips too white, have her apply rouge and lip stick almost to the point of theatrical make-up. The fast panchromatic film, being unable to distinguish between the red of real rosy cheeks and lips and the artificial red of cosmetics, will make the girl look more healthy than she is in real life.

IN EVERY picture you take of people—and most amateur film is used for this purpose—you will notice an improved naturalness and more lifelike effect if you use the panchromatic film. On the beaches, for instance, a healthy coat of tan looks in the picture like a healthy coat of tan and not as though the subject had been swimming in a vat of mahogany wood dye. In short, for any picture you take of colored objects, panchromatic film will give you a more natural picture.

The use of the new, fast, color-sensitive film is not limited to high-priced cameras. It will produce equally good results in the cheapest box cameras and low-priced folding cameras. No special instructions for handling are necessary. Only two precautions need be observed. First, don't load or unload the camera in bright sunlight. Second, keep the red window where the film numbers appear covered with a piece of black adhesive tape except while you are winding the film.

The new supersensitive panchromatic film is faster in daylight than the fastest roll film or film-pack film ordinarily available heretofore. This means, with any type of camera, the diaphragm or lens-opening lever must be moved to the next higher number as compared with the proper setting for ordinary film.

This applies between the hours of nine and three. Early in the morning or later in the afternoon than that, the new film is from fifty percent to several times faster, depending on how yellow the light happens to be.

A still greater difference in exposure time is found when yellow filters are used to bring out clouds or cut through the haze of a distant view. A yellow filter that requires ten times the normal exposure with ordinary film or eight times with the verichrome type, calls only for doubling the exposure when supersensitive panchromatic film is used. In other words, you can use the same shutter speed and lens opening for the new "pan" film and a "ten-times" filter as you would for ordinary film with no filter at all! This is of immense importance to the man who goes in for distant views and cloud pictures. The new film permits fast snapshots under conditions where a tripod and a far slower exposure would be necessary with the old style film.

Indoors, by artificial light, the new panchromatic film is so much faster that taking pictures is simple even with the cheapest camera. For example, if you have only one 35-cent photoflood bulb in a suitable reflector 3 ft. from the subject's face, with a sheet of white paper held up at the other side to cut the shadows, the exposure time with a $2 box camera would be just one fourth of a second. With an F/4.5 lens you can take entirely satisfactory snapshots under such conditions.

Superpan film gives the same shortening of exposure time with photoflash bulbs. At 3 ft. for close-ups, you can set the lens for F/22; and for a group of people 15 ft. away, F/11 gives plenty of light.

Supersensitive panchromatic roll films and film packs must be developed in total darkness. If you develop roll films in a tank, no special precautions need be taken except to keep the paper tightly rolled.

FOR tray development, I recommend using a desensitizing process. The film is treated with a chemical that robs it of much of its light sensitiveness. This chemical is a dye known as pinakryptol green. It is rather expensive, 15½ troy grains or 1 gram costing about $2, but this much makes more than 2½ gal. of solution, and 7 oz. of the solution will desensitize four 3¼ by 4¼ in. rolls, so it isn't so expensive in actual use.

The directions for mixing are supplied with the packages of the dye. Its use is simple. Take a wide-mouth bottle—wide enough so the film will go in edgewise—and fill it with pinakryptol green diluted to working strength. Get your developing and fixing trays ready as usual. Now turn out the light, remove the film from the paper, and let the film down into the bottle of pinakrytol green. Pull it out and let it drop back into the solution several times during the course of about two minutes. You may then turn on your regular dark-room light—one safe for verichrome type films—rinse the film in water and develop in the usual way. Do not have the dark-room light pointing directly at the film, or move the light 6 ft. away as an added precaution.

"I can't stand this stifling bedroom much longer!"

...3 days later Tom got money from the Johns-Manville $1,000,000 Fund to insulate his home

Send for this FREE booklet

Twenty thousand home owners say this is the most amazing booklet ever written about the home. It tells how Johns-Manville Rock Wool Home Insulation not only makes homes 8° to 15° cooler in summer, but reduces winter fuel bills 25% to 40%! Mail coupon *today!*

JOHNS-MANVILLE, Dept. IPS-8, 22 E. 40th St., at Madison Ave., N. Y. C. Please send FREE booklet and details of plan whereby Johns-Manville will lend me the money to have Home Insulation done now.

Name_____

Street City

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FLEXIBLE FLOWER BOWLS SHAPED FROM LEAD

(Continued from page 61)

into 1-in. squares. Place the pattern on the sheet lead and trace around it with a pencil; then cut out the lead with the shears. The end of each arm is bent around a ten-penny nail to form the holder for the flower stem. This may be done with the fingers or a pair of square-nosed pliers. If pliers are used, glue a piece of cardboard on the inside of each of the jaws so that they will not scratch the lead. When this is completed, bend each arm in toward the center of the disk and twist so that the tube for the flower stems will be upright or in whatever position is desired.

For the candlesticks 1/16-in. sheet lead will do, but 3/32-in. stock is better as it will make a more substantial job. Lay out the pieces, two in number, in the same manner as the flower holder. Bend the candle cup, or smaller end, around a broom handle or some other round stick to form a cup ⅞ in. in inside diameter for receiving the candle. This will bring the two column strips opposite each other. Bend these until they are parallel. Then bend the two pieces which form the base into ovals so that when they are put together they form a cone. Press the two column strips together under the candle cup, and twist them very carefully into a spiral column.

CUT a strip of lead 5/16 in. wide by 9 in. long and bend this around to the shape at the bottom of the base. Drill a hole in each end with a No. 20 twist drill, or drive a No. 20 brad through the lead to make the hole. Bring the two ends together and insert a ¼-in. brass wire-shank paper fastener through the holes, and bend the split ends over on the inside. These wire shanks may be bought at most large stationery stores. Slip the hoop down over the base of the candlestick and fasten in place by drilling holes through both pieces and riveting with the wire shanks. The shanks should be evenly spaced to make a good-looking job.

The flange around the top of the candle cup is formed with the square-nosed pliers, if available.

The coasters or ash trays are made from 1/16-in. lead and are 4 in. in diameter. The edges are formed in the same manner as the flower bowl, except that only about ⅝ in. should be bent up with the fingers. The top is flanged out in the same way.

The card tray is also made from 1/16-in. lead. It is 7½ in. in diameter, ⅝ in. being bent up as in the coasters.

Whenever there is any hammering to be done, always use a softwood block to prevent bruising. If care is taken not to scratch the metal, these pieces make a beautiful set. In appearance they are very much like old pewter. Of course, lead dishes should not be used to eat or drink from, and reasonable care must always be exercised in handling lead so that there will be no danger of becoming poisoned.

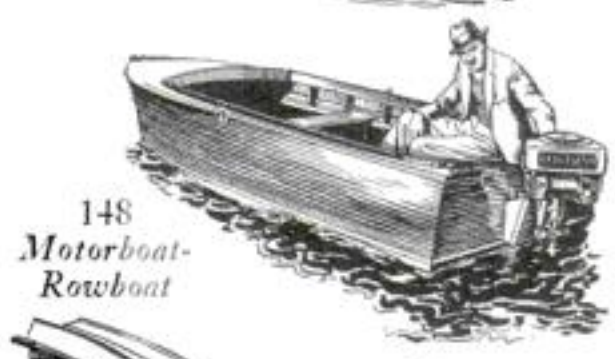
NOTE: *If a sufficient number of readers are interested in sheet lead work, another article on this subject will be published as soon as space is available. Address your requests to the home workshop editor.*

• • •

TO RECEIVE ATTENTION, every inquiry relating to articles published in POPULAR SCIENCE MONTHLY *must be accompanied by a self-addressed, stamped envelope. It is important that the questions be brief and to the point. Mention the article, the page, and the issue of the magazine to which reference is being made.*

128-129 *Outboard Racer*

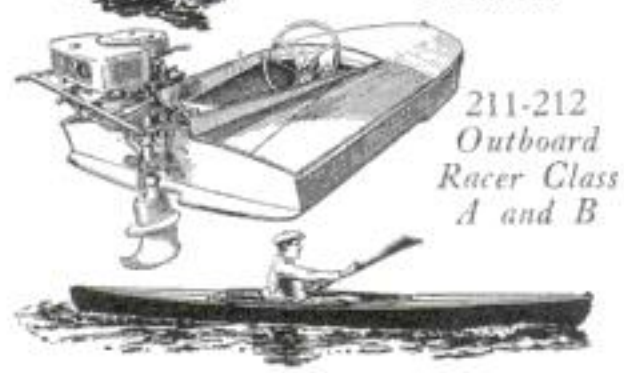
131-132-133 *Combination Boat*



148 *Motorboat-Rowboat*

170 *Folding Duck Boat*

175-176-177 *Runabout*



211-212 *Outboard Racer Class A and B*

192-193-194 *Kayak*

WHICH BOAT DO YOU WANT TO BUILD?

WITH the aid of our blueprints and full-size patterns, you can build any of the fine-looking, efficient, and thoroughly modern boats illustrated above. All of these were designed especially for POPULAR SCIENCE MONTHLY and represent the latest word in their particular class, but their construction is simple and the cost of materials low. For prices of both blueprints and patterns, see the list on page 81.

ARMORED HORNED TOAD BIGGER THAN ELEPHANT

(Continued from page 13)

plates and heavy spines of bone. The little, pig-like eyes, the large nostrils and the sides of the jaws were protected by bony sheaths. A triple necklace of armor plates ran around the creature's neck. And, under the skin, was the secondary line of defense, the subcutaneous coat of mail.

AT THE rear of the body was a long tail encased in rings of solid bone. It made a formidable weapon, the reptile using it as a club, lashing it from side to side in battle. When attacked by the great carnivorous dinosaurs of the time, the creature drew its limbs under its body and hugged the ground. On all sides, it presented bony plates and projecting spines. It was too massive and heavy to lift; too broad and flat to roll over. With all parts of its body thoroughly protected or out of reach, it was practically invulnerable.

Nearly twenty types of plated dinosaurs are known to have inhabited the earth. Fragments of their remains have been uncovered in Wyoming, Kansas, Montana, Maryland, Alberta, Canada, and Czecho-Slovakia. Yet, none of them are exactly like this Montana giant. It represents a new genus of dinosaur.

The nearest approach to it is the Paleoscincus, a prehistoric reptile which led science on a seventy-year trail of investigation.

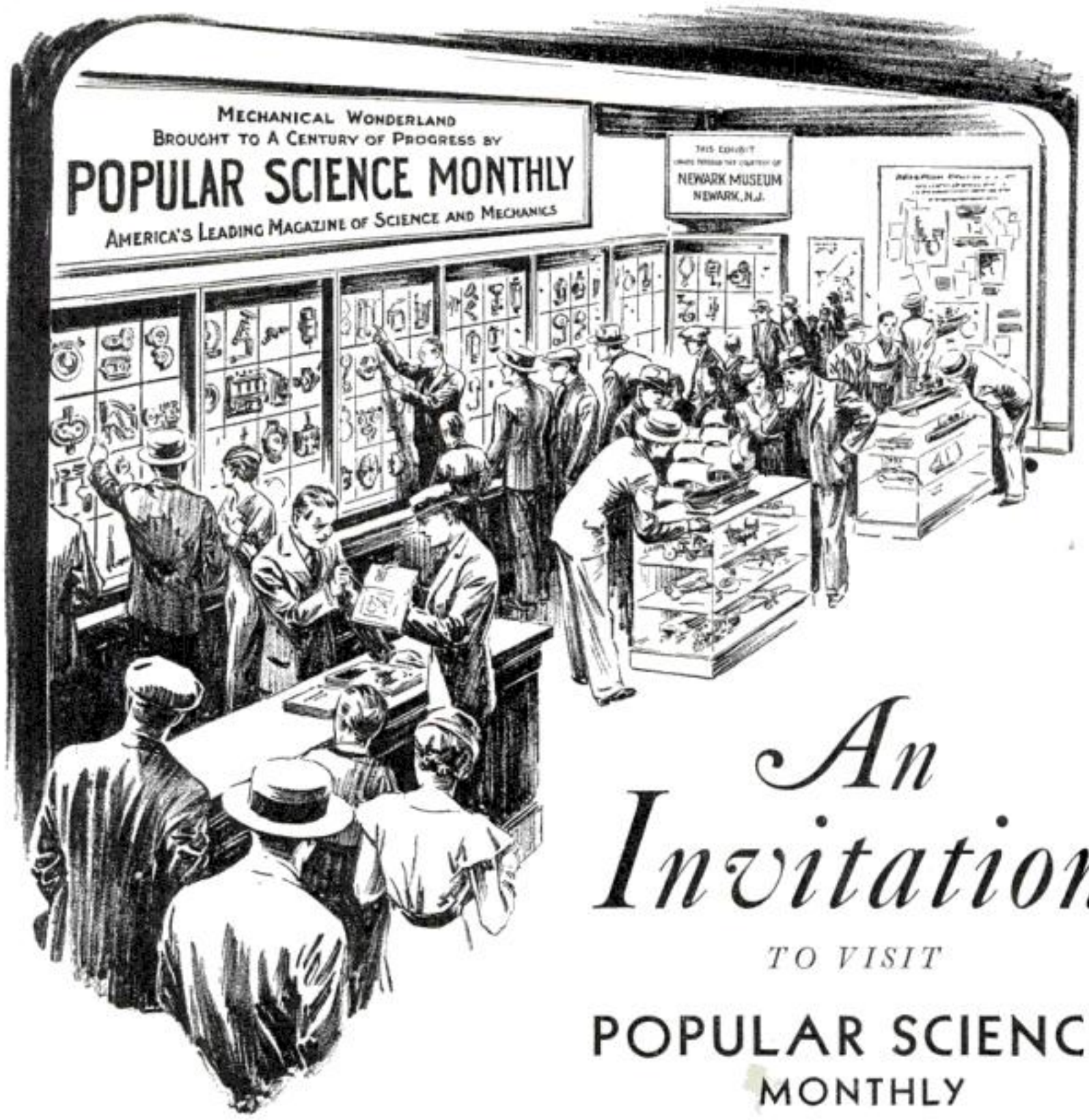
The first clue to the existence of this giant of the past came five years before the beginning of the Civil War. Ferdinand V. Hayden, an explorer-geologist, was traveling in what is now central Montana when he stumbled on a queer fossil tooth. It was unlike any tooth he had ever seen and evidently had come from some prehistoric animal. He submitted it to Dr. Joseph Leidy, paleontologist of the Philadelphia Academy of Natural Science. It was new to science and, because it resembled the teeth of the skink, a small Mediterranean lizard, the unknown creature from which it had come was called the Paleoscincus. The word is pronounced with the "c's" hard.

Fifty-nine years went by. The mysterious reptile of long ago was practically forgotten when Barnum Brown, prowling along the canyon of the Red Deer River, in Alberta, Canada, discovered parts of several skeletons with similar teeth. His find also proved that bits of skulls, parts of jaw bones and fragments of armor plates, which had formed tantilizing clues along the trail, had also belonged to this same type of dinosaur.

Then came a most important discovery. Only a few years ago the veteran fossil-hunter, C. H. Sternberg, and his son, Levi, were going over the rich Alberta field when they found the whole front half of one of these armored giants. The waters of the Red Deer River had worn away the rock containing the rear half of the fossil, leaving a cross-section of the middle exposed.

ALTHOUGH the pressure of rock layers for untold centuries had crushed and distorted the bones, workmen at the American Museum of Natural History were able to extract them from the sandstone and piece them together. Two hundred and twenty-three days were required to complete the job. But, these bones, together with the fragments of skeletons previously obtained, give scientists a pretty clear picture of this mysterious dreadnaught creature of long ago.

Up to a few months ago the Paleoscincus stood for the highest development in protective armor in the animal world. Then came Barnum Brown's expedition to the bad lands of Montana with its thrilling discovery of the unnamed, super-dreadnaught reptile, admittedly the outstanding find of the year by an American expedition.



An Invitation

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POPULAR SCIENCE MONTHLY

AT THE CHICAGO WORLD'S FAIR

I AM happy to extend a cordial invitation to all friends of Popular Science Monthly to visit our exhibit at A Century of Progress International Exposition in Chicago.

You will find it, I am sure, one of the most striking and unusual features of the Exposition. Almost 200 working models unfold for you the entire story of mechanical progress and demonstrate graphically and simply the operating principles of the marvelous machinery of the present day. When you see these amazing models you will understand exactly how engineers generate and transmit power, construct bridges, design automobiles, build ocean liners, and perform the other wonders of our age.

This exhibit is called The Mechanical Wonderland and we are presenting it through the courtesy of the Newark (N. J.) Museum.

In addition, we have prepared other interesting displays which give you a peep behind the scenes and show some of the details of producing our magazine. In the picture on this page an artist has sketched our booth as it will appear for the duration of the Exposition on the second floor of General Exhibit Building One, Group P, Section 2 and 3.

Raymond J. Brown, EDITOR

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Homecraft Kits

KIT G

NO. 2

KIT H

KIT D

NO. 4

KIT A

KIT E

KIT F—Materials for 12-in. model of *Manhattan*

BY SENDING $1.50 to the Popular Science Homecraft Guild, you can obtain a construction kit of raw materials for making a highly simplified 12 in. long model of the U.S.S. *Indianapolis*, one of the latest 10,000-ton cruisers. The kit contains a white pine hull block sawed approximately to shape and wood of the correct thickness for making the various deck units, turrets, towers, funnels, lifeboats, and similar parts; sheet metal for the rudder, anchors, propellers; three sizes of soft wire for the masts, derricks, guns; casein glue, and three small bottles of high-grade enamel. A blueprint showing all the parts full size is included.

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D. Spanish galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet.. 6.45

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E. Battleship model, U.S.S. *Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95

EE. Same with hull lifts sawed.... 7.45

F. Liner *Manhattan*. All raw materials (except paints) for a simplified miniature model 12 in. long, and Blueprint No. 204 1.00

G. Elizabethan galleon *Revenge*. All raw materials (except paints) for a model 25 in. long, and Blueprints Nos. 206 to 209.. 6.75

GG. Same with hull blocks shaped.. 7.25

H. Cruiser U.S.S. *Indianapolis*. All raw materials (with enamels) for a simplified 12-in. model, and Blueprint No. 216.. 1.50

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Note: Prices of all kits except *F* and *H* are 50 cents higher west of the Mississippi River because of heavy shipping charges. We prepay the postage on both cash orders and C. O. D. orders, but if you order C. O. D. you will have to pay on delivery the extra charges made by the Post Office, which amount to 28 cents. Kits *F* and *H* cannot be sent C. O. D. This offer is made only to readers in the United States.

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HOME WORKSHOP BLUEPRINTS

New projects are marked with an asterisk (*)

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. The instructions alone are sold for 25 cents each.

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Winnie Mae, 4-ft., *141-142-143*	.75

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Canoe, 16-ft. Canvas Covered Kayak, with Sail, etc., *192-193-194-R*	1.00
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(Construction kits are available for some of these models. See page 80)

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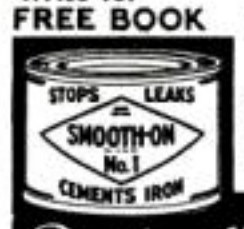

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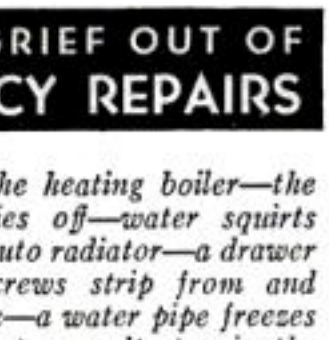

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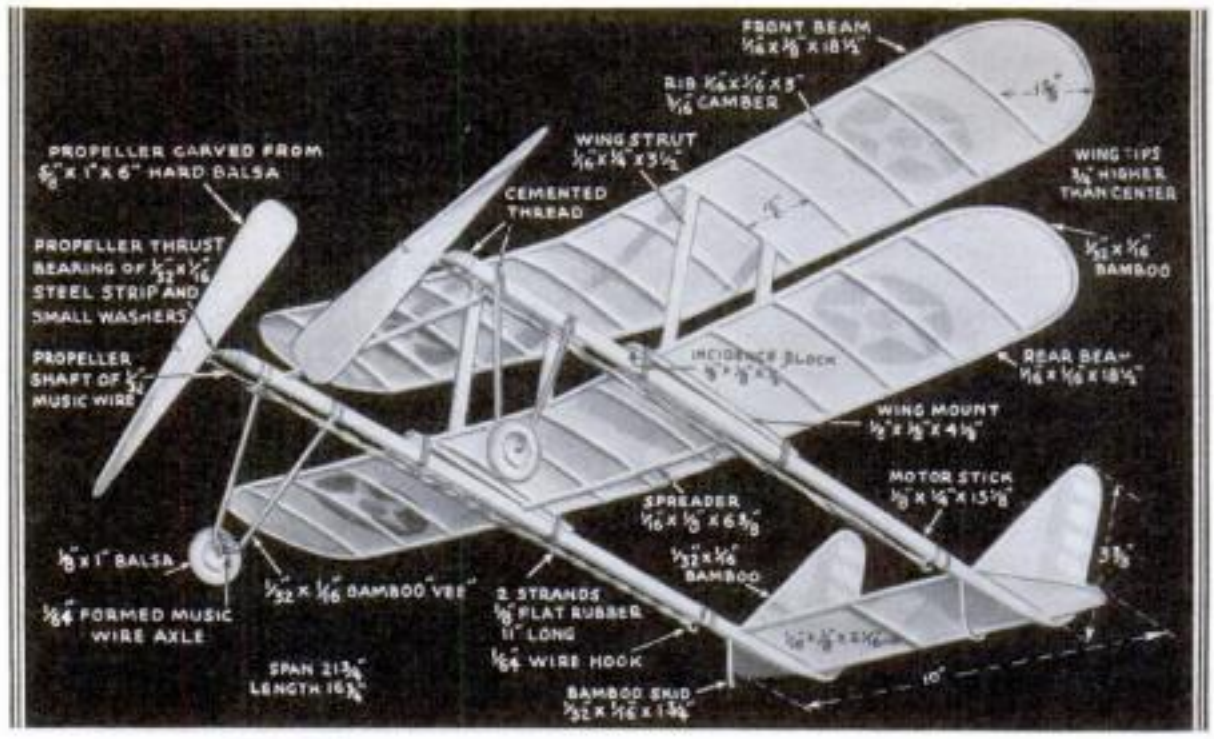


EASILY BUILT Flying Model

looks like big bomber in the air

BY STEWART ROUSE

THIS little bomber flies like a twin-propellered distance model, is slow and light enough not to break easily in collisions, has a big plane thrill about it, and is easy to build. The original was designed by Phil Mates, an expert in model plane construction.

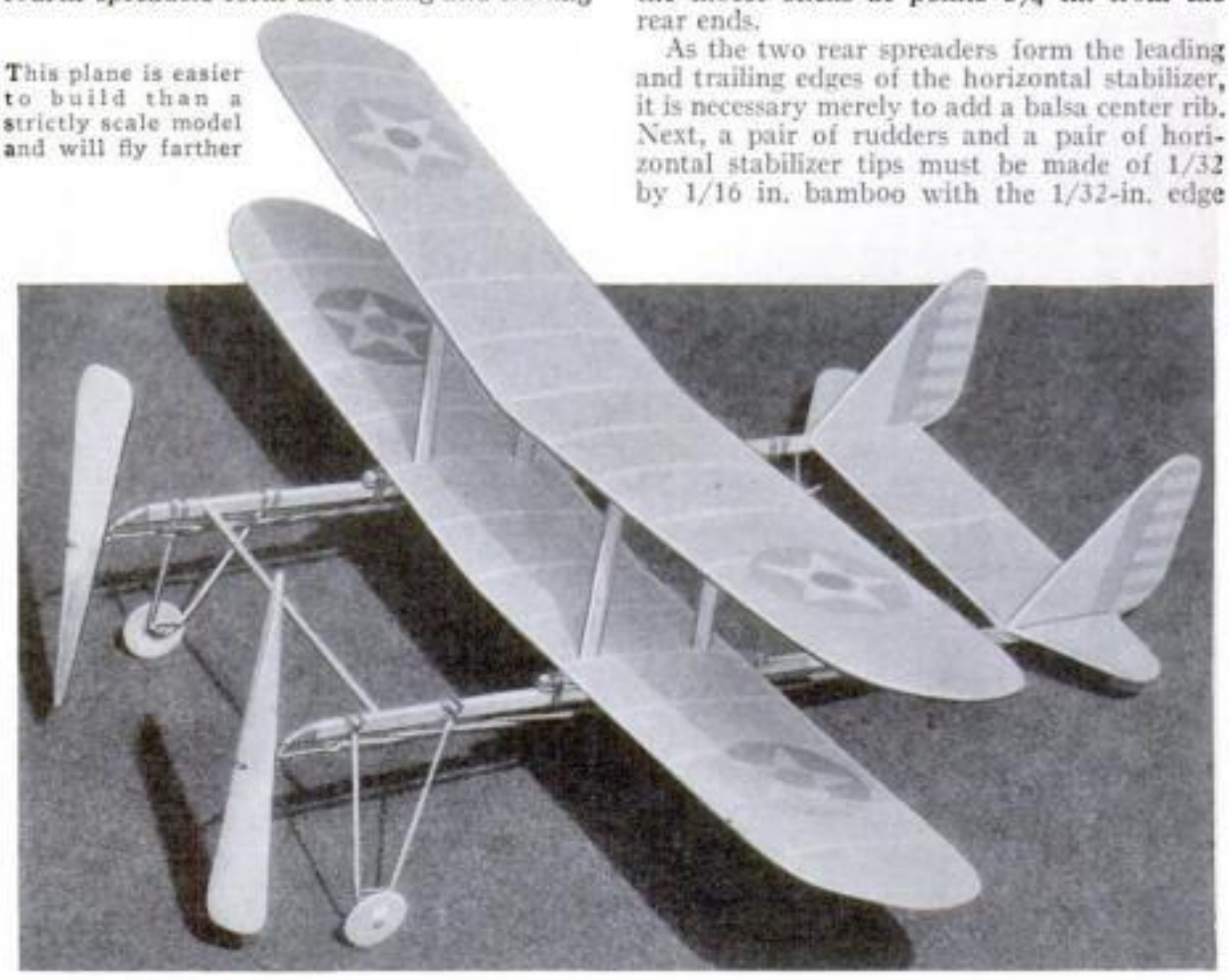
The fuselage is a ladderlike affair with two hard balsa motor sticks connected by four crosspieces of the same material. The ends of the crosspieces are cemented in notches cut in the top surfaces of the motor sticks. The center line of the front spreader is 1½ in. from the fronts of the motor sticks, and that of the second spreader is 7¼ in. The third and fourth spreaders form the leading and trailing edges of the horizontal stabilizer. The drawings contain all the dimensions and details.

The landing gear V's are made by bending bamboo to shape over a candle flame, using a piece which is 1/16 by 1/16 in. in cross section. When satisfied that you have this part shaped right, split it exactly in half and you will have two V's 1/32 by 1/16 in., with the narrow edge forward. Just where the landing gear V's leave the motor sticks, they should be heated and bent outward a little to provide clearance for the rubber motors.

The balsa wheels have small pieces of brass tube glued in their centers for hubs. They are regular stamped balsa wheels with a rough tire effect embossed on one side.

The bamboo tail skids are made like the V's and when finished are of 1/16 by 1/16 in. cross section. They are glued in holes clear through the motor sticks at points 2¼ in. from the rear ends.

As the two rear spreaders form the leading and trailing edges of the horizontal stabilizer, it is necessary merely to add a balsa center rib. Next, a pair of rudders and a pair of horizontal stabilizer tips must be made of 1/32 by 1/16 in. bamboo with the 1/32-in. edge



This plane is easier to build than a strictly scale model and will fly farther

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forward. The ends of each stabilizer tip piece are whittled to thin, chisel-like points and inserted in slits in their respective balsa spreader ends, where they are cemented. The ends of each bamboo rudder outline are similarly pointed and wedged into slits, one in the extreme rear end of its motor stick and one in the top of the stick 2⅛ in. forward of its end.

The medium balsa propellers can be bought ready-made or carved by the builder. One is right-hand and the other left-hand, that is, opposite in rotation. The shaft holes should be drilled before carving. Shafts are made of 1/32 by 2⅛ in. pieces of hard steel wire. Two small German silver washers are slipped on each shaft for thrust bearings. Each shaft is cemented in its propeller, and ⅛ in. of it in front is bent over against the hub and cemented. The rear of each shaft is bent into a rubber hook as shown. Each propeller is powered with a two-strand ⅛ by 11 in. flat rubber motor.

The wings are identical in construction and size. Build each wing flat and install its thirteen bent balsa ribs with cement. The tips are of 1/32 by 1/16 in. bamboo with chisel-like ends inserted and cemented in slits in the wing-beam ends. Ribs are made by dipping a piece of ⅛-in. balsa veneer in hot water and drying it while held with rubber bands on a wood block shaped to the right curve. When dry, the bent veneer is marked with lines ⅛ in. apart, and the twenty-six ribs are sawed off with a fine fret or coping saw.

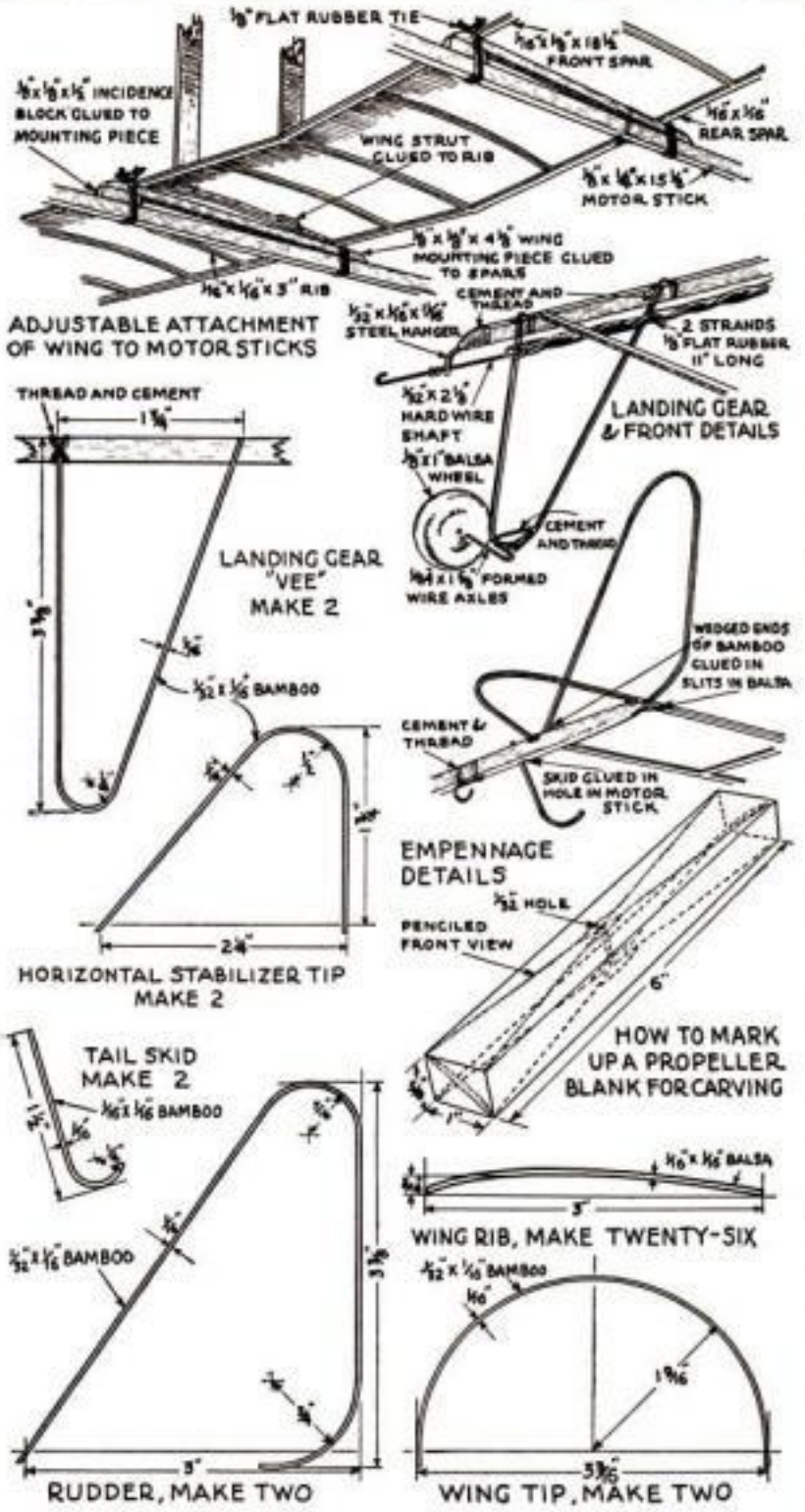
To give the wing its dihedral, the wing beams are bruised deeply on top with the edge of a screw driver set across the grain right at the center. The beams are then bent up at the tips until the tips are ¼ in. higher than the center. Then the bruised center points must be well repaired with cement. Four interplane struts space the wings.

The wing mounting pieces are made of balsa and cemented to the front and rear wing beams, as shown, exactly over the motor sticks. At the front of each mounting piece is cemented a small incidence block. The bottom wing is fastened to the motor sticks with ⅛-in. flat rubber.

The wings must be covered on top only with a good grade of tissue paper glued on with banana oil. One half of the wing from the center rib outward is covered at a time. The wings should be covered before the struts are glued between them.

The stabilizer is covered on top, and the rudders on their outer surfaces. When everything is properly covered, the paper is tightened with a spray of water from a fly spray gun.

To adjust the model, just slide the wing-cell back and forth until it glides swiftly and steadily. For a first flight in still air wind the propellers until the rubbers show a full row of knots, then give each propeller 100 more turns, set the model down on a smooth floor or street, and you will have the thrill of seeing your plane take off fast. For duration flying, a winder should be used.



How the wing is attached and details of the wing ribs, the wing and stabilizer tips, rudder, landing gear, and propeller

MAKING COLOR FILTERS FOR MICROSCOPE

Color filters are sometimes necessary in microscope work in order to bring out details of crystals or other subjects having depth. An inexpensive way to make suitable filters is to place colored cellophane between two slides and cement them together. Such filters are almost as satisfactory as those used professionally, and there is no appreciable difference on low powers. Red and green may be made first, and then other colors added later to complete the set. Another hint useful to the beginner is to place a piece of ground or opal glass under the subject slide when necessary for the purpose of insuring an even distribution of light.—Oscar Freeman.

CORN HUSKS COVER MODELS

Inner corn husks provide a strong covering for model airplanes and give the appearance of corrugated metal. Pieces up to 4½ in. wide and 7 in. long can be obtained. They should be glued on with the corrugations parallel to the line of flight.—Everett Thayer.

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The "*REVENGE*" Spreads Her Canvas

(Continued from page 72)

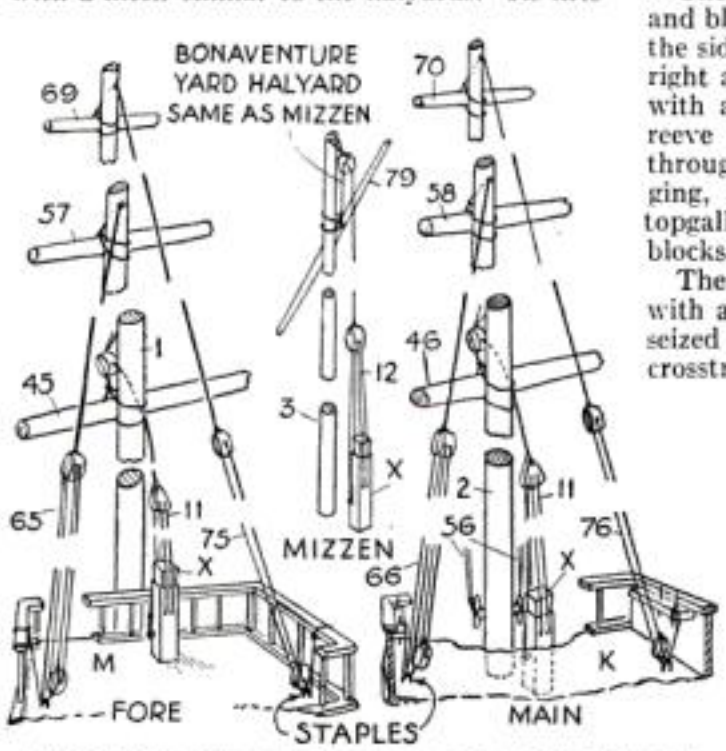
Haul the clew lines *61* and *62* tight. The hauling parts of the bowlines *63* at the fore should be reeved through beads hitched to the fore-topmast stay and down to the grating, where they are hitched. The same parts *(64)* at the main go through similar beads on the stay, through others on the foreshrouds, and to the deck.

The topgallant halyards *75* and *76* are similar, of *b* cord, but they have two single blocks and go to the opposite side of the deck. The bowlines *73* at the fore are reeved through beads on the stay, through others on the same stay down near the bowsprit, and to the grating. Those at the main *(74)* go through beads high up on the stay, through others at the eyes of the topmast rigging, and to the deck or top.

The mizzen and bonaventure yards *(79* and *80)* have similar halyards except that the blocks are abaft the masts and the yards go up on the lee side, inside the rigging. The lower ends are held in position, across the ship, by one or two tacks *(83* and *84)* carried to the handrail or pinrail. The mizzen sheet *85* is fairly slack, and the bonaventure sheet *86* comes to a short spar or bumpkin *87* projecting about 1½ in. This spar is let through a hole in the stern board and nailed to the poop deck.

The mizzen should have a crow's-foot and span *88* from the upper end leading to the main topmast crosstrees and down. The bonaventure has a similar crow's-foot and span *89* to its own topmast.

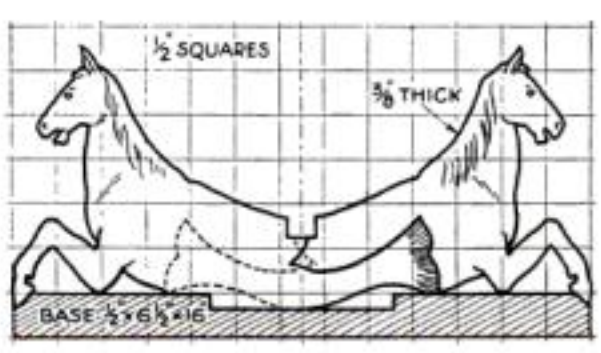
The spritsail *91* is fastened to the bowsprit with a hitch similar to the halyards. Its lifts



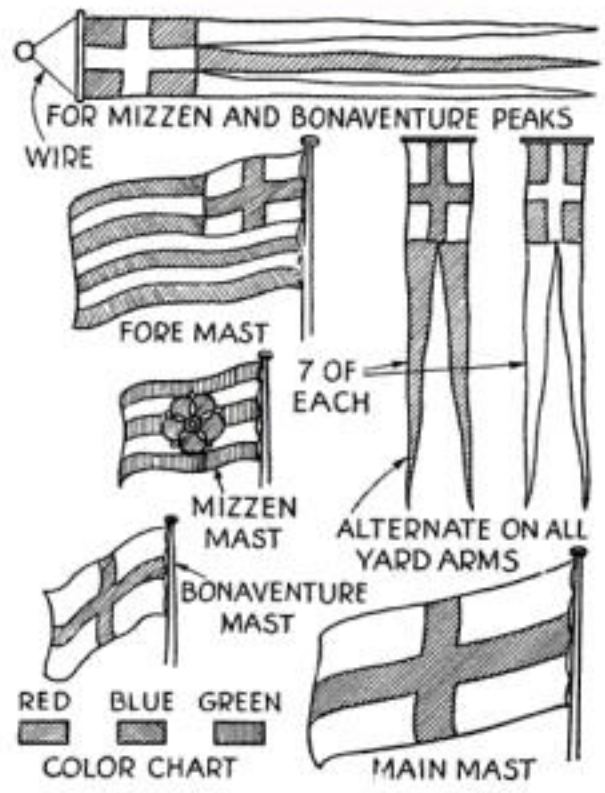
These three diagrams show at a glance the halyards for main, fore, and mizzen yards and belaying points

and braces *90* are in one cord. Start by hitching the bight to the yardarm *90*, lead one end through a block, and hitch to the stay and back to the forecastle handrail. The other end goes through a block well up on the forestay and back to the handrail. Both sides are alike, of course.

The braces should be left until now, because they would be in the way before. The forebrace *93*, on each side, has a pendant some 2 in. long with a ¼-in. block in the end; then the runner hitches to the mainstay, reeves through the pendant block, through a double block lower down



A suggestion for making a stand. The twin sea horses are tenoned into the baseboard



Flags and pennants and a chart indicating their colors. The untinted areas are white

on the stay, and to a cleat. The fore-topmast brace *95* is very similar, of *b* cord, and the topgallant brace *97* is single, of *c* cord, leading through a double block on the main topgallant stay *42*.

The main braces *94* have similar pendants and blocks, with other single blocks stapled to the side of the hull or belayed to the handrail right aft. The main topmast braces *96* start with a hitch at the mizzen lowermast head, reeve through the pendant blocks, back through blocks seized to the eyes of the rigging, and down to the pinrail. The main topgallant braces *98* are single, leading through blocks at the mizzen topmast rigging.

The flags are stitched to little flagstaffs, with a truck (ball) on top. These staffs are seized to the mastheads, unless you have fitted crosstrees and caps. I gave my ship, at the fore, an admiral's flag of the period; the St. George's cross at the main, a Tudor flag at the mizzen, and a smaller St. George's cross at the bonaventure. In addition, I gave her large pennants at the lateen sail peaks, and smaller ones at all the yardarms, alternating red on white and white on red. This is quite permissible for the period, when ships went into battle with all their bunting flying.

I glued these pennants to slips of bamboo and used thin wire to hold them; this makes them easy to fasten and holds them out. The flags can be painted on silk or paper.

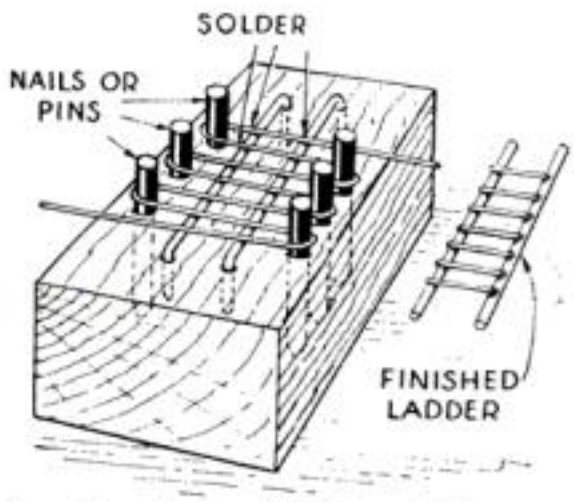
The base for the model can be of any pattern. I used a board ½ by 6½ by 16 in. Then, of similar wood ⅜ in. thick, I fret-sawed uprights to the pattern shown, representing conventional sea horses. The inside curves are the hull construction lines III and VII, and should fit in those positions, but it is better to try out the curves with cardboard before cutting. The uprights are let into the baseboard or glued and screwed down. The horse's feet should lie on the bevel of the board as shown in the drawing at the left. If desired, the mouths can be touched up with red and their hoofs, manes, and tails gilded. If a suitable piece of hardwood for the baseboard is not at hand, the sea horses can be slightly redesigned and a piece ½ by ¾ by 12 in. used as a connecting bar between them.

By now you should have a very fine and beautiful model, and if you have built other models, undoubtedly the best looking of your collection. You have caught the little *Revenge* just before her last fight with fifty-three Spanish galleons off Flores, in the Azores—a battle that lasted a day and a night. As Tennyson described it:

"And the sun went down, and the stars came
out far over the summer sea,
But never a moment ceased the fight of the
one and the fifty-three.
Ship after ship, the whole night long, their
high-built galleons came,
Ship after ship, the whole night long, with her
battle thunder and flame;
Ship after ship, the whole night long, drew
back with her dead and her shame.
For some were sunk and many were shatter'd,
and so could fight no more—
God of battles, was ever a battle like this in
the world before?"

This is the fifth and last of a series of articles which began in the April, 1933, issue. Another series by Captain McCann on ship model tools, materials, and methods is scheduled for early publication.

A QUICK WAY TO MAKE SHIP MODEL LADDERS



How the wires are held for soldering, and a ladder after being removed and trimmed

WIRE ladders for ship models can be made quickly by the following method: The ends of two pieces of copper wire are fastened to a board at the desired distance apart to form the uprights. Small nails or pins are then driven into the board outside these wires and spaced as far apart as the rungs of the ladder are to be. The diameter of the nails or pins should be about the same as the spaces, or they should be placed as far as possible outside the wires which are to form the uprights in order to minimize the zigzag effect. Fine copper wire is then wound across from pin to pin as shown and soldered to the thicker wires. The pins are removed and the surplus wire is cut away. Several ladders can be made at one time by inserting the desired number of uprights.—R. J. HEINEN.

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HOME TESTS YOU CAN MAKE WITH IRON

(Continued from page 51)

from the base of the crucible in a molten, white-hot state.

How this is used to form a weld is shown in the drawing. A mold first is made around the portions to be welded. Then the thermit mixture of aluminum and iron oxide is placed in a conical crucible fitted into the entrance gate of the mold. When the mixture is ignited by means of a strip of magnesium, the reduced iron, heated to an enormously high temperature, flows into the mold.

With some aluminum paint powder, a small amount of powdered magnetic iron oxide, and an old flowerpot, the amateur chemist can reproduce the thermit process on a miniature scale. Mix the iron oxide and the aluminum powder in the ratio of one to two and place the mixture in a three-inch flowerpot. It will be necessary, of course, to plug the hole in the base of the flowerpot.

To ignite the thermit charge, a priming starter will be needed. For this starter, the experimenter can use five parts of barium nitrate, two and one-half parts of aluminum powder, and one part of sulphur by weight. Place this in a small depression in the top of the thermit. To light the charge, use two or more large matches held in a pair of pliers.

Once started, the reaction continues with intense brilliancy and heat. Few experiments are as spectacular as the reduction of iron oxide by the aluminum in the thermit process. The mass will glow and sparks will jump as the aluminum burns by removing the oxygen from the iron oxide.

When experimenting with the thermit mixture, always work with one or two ounces of the mixture and confine the reaction to some heat-resistant and insulating receptacle like the flowerpot. Good results will not be obtained if the mixture is fired in piles as, in that case, the heat is dissipated too rapidly.

HOW THE MOON AND PLANETS TRAVEL

(Continued from page 41)

Now note the point in the sky behind the edge of the rule where the scale indicates thirteen of the half-inch degrees. Here is the point at which the moon will be on the following night. By measuring off thirteen degrees more along the slanting moon's path to the left, you can find the position of the moon two nights later. Continuing thus, you can get the moon's position for each night of the month.

To get the most fun out of this, you should enlarge your chart of the stars and planets along the moon's course and mark upon it the moon's position for five or six nights in advance. Then you will get the thrill of seeing your predictions come true.

You can thus forecast the dates when the moon will overtake and pass the different planets. During the last few days of July, she will pass very close to Venus, Jupiter, and Mars in the order named.

If you are sufficiently accurate about it, you can predict the change in the moon's position during four or five hours of the same evening, for the moon advances its own breadth among the stars in a single hour. This seems a small distance, when measured by you on the sky, but it represents about 2,000 miles along the moon's path, which gives you, of course, the speed at which the moon moves.

In the article in this series which will appear in the September issue, we will try some experiments in practical astronomy. We will build a simple cardboard model of the sextant which mariners use to find the latitude of a ship at sea, and also find out how the chronometer is used to get vessel's position.

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Death-Defying Stunts of Circus Dare-Devils

(Continued from page 24)

they get out of condition was illustrated tragically a few years ago. Hans Jahn, son of a head balancer, had climbed to the swaying top of a thirty-foot perch pole balanced on the shoulder of his brother. He was just starting to stand on his head when he became dizzy, fell to the floor, and was killed.

The head balancers are among the great chance-takers of the circus. The slightest slip or defect in the apparatus will send them plunging head-foremost to death or serious injury. In Philadelphia, last year, Juan Olvera was fatally injured when a property man tightened a guy wire just a little too tight.

Juan Olvera and Juan Ortiz were "head sliders." They wore leather skull caps containing a groove that fitted over the wire. In this way, they slid from a perch eighteen feet high down a wire to the ground, balancing on their heads. At Philadelphia, Olvera was taking his position when he motioned a property man to tighten a guy wire. The attendant obeyed and the taut wire snapped. Olvera went over backward and broke his neck. Juan Ortiz is doing his lone head slide in our show today, still wearing the same ring costume he wore the day his brother professional was killed.

EVERY possible precaution is taken to protect the lives and limbs of circus people. They play the game as safely as possible, and as a result, serious accidents are exceptional. Nor do such accidents dampen the ardor of youngsters who aspire to fame in the sawdust ring. At the training schools where these kids are taught the tricks of bareback riding and gymnastics, there are always more applicants than can be accommodated.

Of all the spine-tingling acts put on by head balancers, probably the most thrilling is Ira Millette's inverted ride on his swinging trapeze. Fifty feet above the ring, he balances on his head on the slender bar of the moving trapeze. Ira has never fallen, but, as he works without a net, one fall will be sufficient.

The Great Powell, from Tennessee, does one of the most sensational trapeze acts in the circus business. While swinging rapidly fifty-two feet above the crowds, he performs amazing feats of bodily contortion. He has figured out that, if he loses his balance, he has two chances. If he falls head downward, his feet may catch in an angle made by the side ropes and bar. If he falls feet downward, he may catch the bar with his hands. So far, he has done neither kind of falling. In common with all acrobatic stars of the circus, however, he has figured out every possible move for an emergency.

But, curiously enough, it is often the simple, seemingly unimportant accident that lays up the performer instead of the spectacular emergency he prepares for. Orrin Davenport will tell you that, while he has missed many a cross-over somersault because the horse behind the one he was riding did not keep the proper distance to the rear, he has been injured more often in turning the simple-looking pirouette on one of his fat rosinbacks.

THE pirouette is a revolution of the upright body. Try it on the floor and you will get the idea. Unless you are an accomplished dancer, you will find it difficult. On the back of a moving horse, it may look easy, but it isn't. Unless the equestrian completes the turn in the air, he is apt to lose his balance and land on the curb of the ring. This is why Davenport prefers a back somersault from one horse to another, even though the rear horse may step on him if there is a slip.

Another bit of business that is far more dangerous than it looks is Clarence Bruce's jump-up. Bruce, our champion somersaulting equestrian, finishes one act with three women standing erect on a fast-moving horse. He leaps from the ground to the back of the animal, landing on its rump. Early this spring, he made the jump and landed all right. But in his effort to help the three women maintain their balance, he went off the horse and broke a bone in his foot on the wooden curb of the ring. It was eight weeks before he could ride again.

MANY people have wondered why we give Con Colleano a "spot" for his tight wire forward somersault while he does his back somersault without much ado. The answer is because the forward spin is far more difficult and dangerous to perform. The tight wire upon which Colleano works is less than a quarter of an inch in diameter and will cut him like a knife if he strikes it improperly. He accomplishes the crotch-to-feet somersaults almost automatically. He has a perfect record with these tricks. Nine out of ten times he does his backward flip from feet to feet without a miss. But, in the forward somersault he has to use all his skill and sense of balance, because, in turning the backward somersault he can *see* the wire as he comes down, but in the forward somersault his face is away from the approaching wire.

Colleano is the only one doing this risky trick consistently. He averages eighty-five successes on the first attempt in every hundred tries. Incidentally, he and Codona have a private little "sweepstakes" race against perfection each year. Every time one of them misses on the first try, he has to drop half a dollar in a box. At the end of the year, the one with the fewer misses takes the money.

In his forward somersault, Colleano depends upon intuition to tell him where the wire is located. If instinct, sharpened by years of experience, tells him he is coming down an inch or two to the left or right of the wire, he twists his feet accordingly. He has studied just how far the slightest twist will carry him.

Hugo Zacchini, the "Human Cannonball," is another performer who has figured out the effect of every movement of his body in the air, calculating the various forces as a mathematician studies the flight of a projectile. Since 1922 this shooting comet of the circus has been fired from a cannon's mouth, sailing 145 feet through the air into a net. He has calculated that he can guide his body six feet to the right or the left or can shorten or lengthen his flight nine feet by controlling his position during the three seconds he is hurtling swiftly through the air.

HE HAS also calculated the exact change in the elevation of the cannon which is necessary when he reaches a city like Denver where the atmospheric pressure is less than at sea level. Fired at the same angle and with the same force in such rarefied air, he would overshoot the net. When it is necessary to alter the distance between the cannon's mouth and the safety net, test shots are always fired with a dummy exactly the performer's size and weight. Although he is in the air hardly six seconds during the two daily performances, he and his brother put in practically eight hours a day going over the mechanism of the cannon, servicing and inspecting it, to be sure it is in perfect condition.

Unless Zacchini hits the net on his shoulders at the end of his arc through the air, he is likely to injure his spine. His younger brother, Victoriano, sustained a back injury while being thrown nearly 200 feet at Coney Island, N. Y., last summer. Hugo's older brother, Edmundo, broke his legs five time while perfecting the cannon's mechanism. So far, twenty men are said to have been killed trying to emulate the daring feat of the Zacchini brothers.

The cannon act is risky, which gives it its great drawing power. Hugo now contemplates an even more spectacular variation. He plans to be shot out through a hole in the roof of the tent, come down through another hole in the canvas after crossing the tent peak, and take his bow from the safety net in which he lands!

The stunt can be done and should appeal to the public, which, while it doesn't really want any one killed, delights in seeing some other human being take long chances. That's why Desperado was such a sensation in the old Madison Square Garden.

LIKE Harry Rittley, Desperado was a professional diver. Standing on a perch at the top of the Garden, he would dive forty feet through the air, land in a metal chute on his chest and slide to safety while the crowds first held their breath and then broke into wild applause. Only the most exact timing and judging of distances made that thriller possible. Yet, Desperado is still alive and well.

So is Tiny Cline, who specialized in a daring teeth slide from the top of the tent to the ground. Once, in Toronto, Canada, she came down so fast that the men who were supposed to catch her, muffed their job and she jammed into a post and broke three ribs. Last winter, at an indoor circus at Hartford, Conn., she had another accident which was far more serious although her injuries were less severe. She lost the thing her act depended upon when several of her teeth were knocked out. So, she regretfully gave up her pet ambition, which was to slide down a rope, hanging by her teeth, from the top of the Empire State Building, in New York City!

NEW TELESCOPES CATCH ULTRA-VIOLET LIGHT

NEW telescopes for studying invisible starlight were announced recently at Ithaca, N. Y. By coating mirrors with evaporated chromium and aluminum, two Cornell University physicists have produced reflecting surfaces which catch ultra-violet light from stars in far greater quantities than is possible with the silvered mirrors now used in studying heavenly bodies. Parallel furrows, made with a diamond point and only one-thirty-thousandth of an inch apart, are cut into the surface of the glass. Then in a vacuum chamber, the metals are heated by an electric furnace until they rise in the form of vapor. This vapor condenses in the furrows on the glass, forming a film only a few molecules thick which has remarkable reflecting power and passes the ultra-violet light through glass prisms and spectroscopes to photographic plates which record the color bands in permanent form.

BLIND GLIDER FLYING NEW GERMAN STUNT

A NEW thrill has been added to glider flying at the famous German soaring school on the Wasserkuppe Mountain in central Germany. Advanced pupils are now being given instruction in handling the motorless machines within enclosed cockpits, flying blind, feeling their way from one rising current to another. The instructor, seated in an open cockpit in front of the student, takes off and lands, and takes over the controls in the air if the beginner gets into trouble.

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FLOWERS FOUND WITH YOUR MICROSCOPE

(Continued from page 35)

the low-power objective, and then with the high-power. The patient observer will discover many interesting things about diatoms. Each individual is encased in what is known by the botanist as a frustule. If it is examined closely, it will soon be seen that the cell wall is made up of two similar valves nearly parallel to each other, and each provided with a connecting band projecting from it at a right angle.

A PILL box and its cover give us a good idea of the way in which one of the valves of a diatom fits inside the other. In a sense, a diatom is much like an animal growing inside a pill box—the larger the animal becomes, the more the pill box expands. As the protoplasmic contents of a growing diatom increases, we find the valve expanding to take care of the growth.

No student can gaze upon these intricate and wondrous forms without being seized with a desire to prepare specimens in mounted form. Once a supply of the living diatoms has been discovered, this is an easy matter. The mud from a creek or pond bottom that we learn from examination contains a large number of diatoms, is placed in the bottom of a small wide-mouthed glass vessel. A strong solution of either hydrochloric or nitric acid, one part acid to one part water, is placed over the mixture and the whole boiled slowly until part of the water and acid evaporate.

The liquid that is left is carefully siphoned off, care being taken to prevent the end of the siphoning tube from reaching the bottom of the container, as all of the specimens will settle to the bottom after the boiling and your siphon may easily drain off the very finest specimens you have collected.

Over the residue, clear water is poured and this in turn is siphoned off after the earth, containing the specimens, has been given time to sett'e to the bottom of the container. As the next cleansing operation, the earth is boiled slowly in carbonate of soda and after an hour or so the heat is turned off and the earth permitted to settle. This solution is siphoned off and replaced with clear water. After this last washing with water and final siphoning, the specimens are ready to be mounted.

Just a speck of the moisture remaining in the bottom is transferred to a clean microscope slide. It is left there until all of the moisture has evaporated. Naturally, this operation may be speeded up by slow heating and it is really best to do this to be sure there is no water in the finished mounting for if any remains it will spoil your work.

AFTER the speck left on the slide has been thoroughly dried, it is covered with a thin layer of dilute Canada balsam which is permitted to set after a thin cover glass has been put in place.

In the preparation of diatom slides in this manner, the worker should not stop at one slide. In a single teaspoonful of the right kind of mud, there will be found enough diatoms for many slides. Indeed, each little speck of dirt will contain a number of them. For that reason, at least two dozen slides should be prepared at a time. Even then, you will have only a very small number of the large family of diatoms.

As time goes on, our collection of slides will grow until we have so many boxes of slides that it will be advisable to make some kind of a cabinet for them. In such a cabinet, they can be classified so they will be instantly available. The cabinet need not be elaborate. In fact, a cabinet made from cigar-box wood, of the general type shown at the head of this article, will meet the needs of most amateur microscopists for years to come.

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EXPECTING to find a position immediately upon arriving there, I spent all that I had saved in two years as a publisher of a small weekly newspaper, and bravely set forth with my family on the 2,500 mile trip to Ohio—only to find that jobs there, of any kind, were almost as scarce as the dodo bird. I borrowed money and came back to Washington just as soon as the roads were open for motor travel the next spring.

Arriving here we found that no editors, printers, or even devils were needed, and as I had no money to buy one of the many papers which were offered for sale, I was forced to see what else I could do to provide for my family.

As a boy I had helped my father repair clocks and sewing machines; later I added bicycle repairing to my list and also got considerable experience in electrical work. I was also a radio bug, beginning experiments with that "'way back when" I was a member of the old Popular Electricity Wireless Club. I had a faculty of being able to quickly understand almost any kind of a mechanical contrivance and locate trouble. All my life—at least after I reached the "teenage"—I was the handy man for the family and neighbors, and seemed to be always fixing something for somebody.

Thinking of all this past experience gave me an idea.

I secured a small building just off of Main Street, gathered together my tools, built a work bench, installed a small wood-turning lathe (which I also sharpen lawnmowers on), laid in a small stock of parts and material, and ADVERTISED.

I called my place The FIX-IT Shop, and the name was novel enough to attract attention. I run an advertisement each week in the local paper which I pay for by working there on the day the paper goes to press.

AT FIRST the public was skeptical of my ability, but a few jobs well done brought repeaters and new customers until now I am doing better than I had thought possible in a community this small.

To show the variety of work which I have handled, the following list is given: I have cleaned chime, strike and alarm clocks; repaired sewing machines; done considerable electric wiring in the fruit warehouses *(Continued on page 89)*

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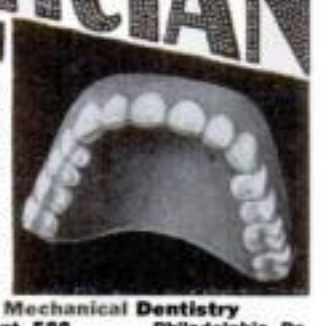

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(Continued from page 88)

and private homes; repaired guns, phonographs, typewriters, automobile generators, radios, electric appliances, furniture, locks, refrigerators, farm machinery, spectacles, etc. I solder jewelry, kitchen utensils, incubators, aluminum and granite ware, and what I can't solder I patch. I sharpen scissors, lawnmowers, knives, saws, axes, and 'most anything. Repairing the celluloid and zylonite spectacle frames makes a great hit.

My income is very small, and a great deal of it has been in the form of fuel, vegetables, fruit, etc., but I am keeping out of debt and making a living, besides paying a little on the shop building which I have bought. I do not claim credit for being a genius. I believe that any man who is mechanically inclined and handy with tools can do the same as I have, and it is surprising how quickly people will come to patronize a place of this kind. A man in a city could start this same kind of a shop and make dollars to my dimes. I know that I could, but I wouldn't live in a city for the best job in town. However, here's an idea for the man out of a job in town. Honesty, careful work, and a reasonable price will get the business.—B.M.W., Oroville, Wash.

• • •

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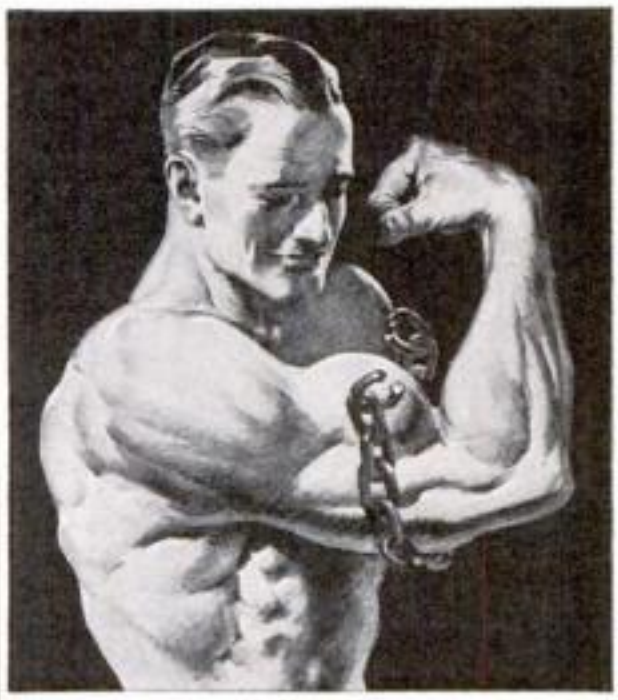
I go through all the publications I can reach in the public library. I note the different publications that use jokes, children's bright remarks, recipes, household hints, machine shop hints, and the like. The field, of course, is illimitable, every trade having its own hints and its own journals.

I collect recipes that my friends find pleasant—and if I manage to sell them, I divide the *(Continued on page 90)*

MOULDING A MIGHTY ARM



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(Continued from page 89)

amount received with the originator of the recipe. My friends are more than happy to aid me—and of the chance of earning a few cents on the side. For recipes, the amount paid varies with the publications—ranging from fifty cents to fifteen dollars. The high rates are paid only in contests to the winner.

The same is true of children's bright remarks. I have the brothers and sisters of tots, and even the mothers keeping a sharp lookout for bright sayings of their children. With these, I work in a similar manner—giving half of what I earn to whomever has brought me the tip. Of course I discover my own jokes and occasionally sell a joke originating in a twenty year old child. These jokes bring in from fifty cents to five dollars.

Constant browsing through magazine articles, stories and encyclopedias unearths many interesting, unusual facts. These are sent to the numerous magazines and newspapers running columns of 'Did You Know That?' and others, similar to Ripley's 'Believe It Or Not'.

Household Hints are collected with the aid of women acquaintances; mechanical aids are gathered through the courtesy of mechanics that I know; special trade aids are gathered from those in the trade and by keeping my eyes open.

In this manner, I have succeeded in making myself financially independent, am my own boss—and have been of service to almost all my friends at one time or another.—W.H., Cleveland, Ohio.

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WHY YOUR CAR'S MOTOR WILL OVERHEAT

(Continued from page 56)

low speed may be lifted clear off the fan pulley by centrifugal force at high speed. A belt can be pretty loose and still drive the fan when the motor's idling."

"It certainly beats all how you can root out trouble on a car," Crowley said admiringly to Gus when the trip to Round Lake was resumed. "How'd you know the cooling system was clogged up. All you did was pat the radiator here and there."

Gus chuckled. "You're right, that's all I did but it told the story. And that's the simplest way to find out what's the matter when a car overheats. Your radiator was cooler at the bottom than at the top. That showed me the water wasn't circulating. If it had been hot all over, I'd have known the water was circulating but not as fast as it should.

"IT NEVER fails. If the radiator's hot all over, look for a loose fan belt, a clogged radiator, too rich a mixture, or punk ignition. If it's cool at the bottom, something's completely shutting off the water."

"Yeah, and fan belts cause most of the trouble," Joe added. "Nine-tenths of the cars that are brought to the Model Garage need new fan belts, don't they, Gus?"

The mechanic agreed with a nod. "And the tough part of it is, loose fan belts cause a lot of other troubles especially when the fan belt runs the generator as well as the fan. If it slips, the generator slows down. That means the generator doesn't charge the battery as fast as it should."

"Gosh!" exclaimed Crowley shifting into second gear for the long pull up Round Mountain. "I never thought of that. At that rate, you ought to check the fan belt every time you use the car."

"That wouldn't be a bad idea," Gus agreed. "But it's simpler than that. The fact that the fan belt drives the generator makes it easy. All you've got to do is check the ammeter reading now and then when all the lights are off. If it reads lower than usual, the first thing to look for is a loose belt. Then about once every month let a service man look at the belt just to make sure it's O. K.

"And another thing," Gus went on. "Loose fan belts and clogged radiators aren't the only things that'll make an engine overheat. A weak ignition coil can cause a lot of trouble too. If the coil is breaking down, the engine misses fire and overheats.

"LOTS of times a high compression motor will overheat because the engine gasket has blown internally. The cooling water leaks into the motor and the exhaust fumes escape through the radiator."

"Motors must be like people. As soon as they get sick they run a temperature," Crowley grinned.

"Right, and that's why it pays to go over your car now and then and get it in shape," said Gus. "After a hard winter, a car needs some attention. Flush the radiator, clean the honeycombs by squirting a hose at them from the inside, change to summer oil, go over the ignition system, check the carburetor, and clean up the motor generally.

"In other words," he concluded "give your car a spring cleaning if you want your summer trips to be free of trouble."

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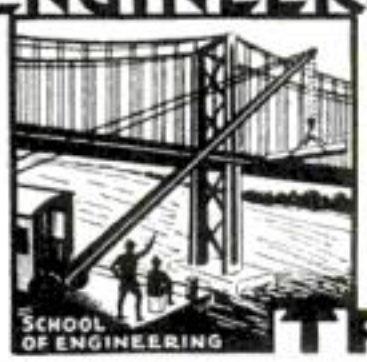

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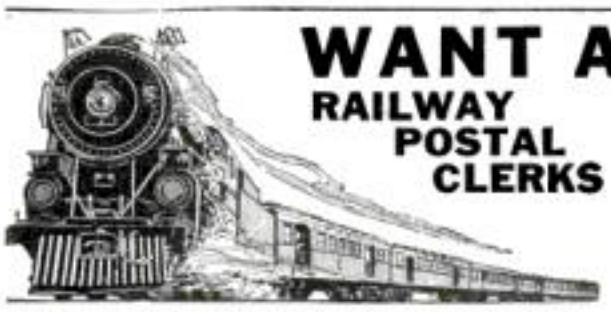

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HOW DISEASE ACCOUNTS FOR LOST PERSONS

(Continued from page 26)

the result of overwork. A man has a tremendous capacity for work in which he is keenly interested. But amnesia may result from an intense dislike of work, or of the surroundings in which the work must be done, or from failure in work which the patient really likes. Often it is caused by frustration, by repeated failures to do something that the patient has set his heart on doing. A man can't succeed, and he won't give up. A subconscious desire to escape from his unsolvable problem may cause him to forget that problem and everything connected with it. It isn't the actual work that beats him—it is his inability to do what he is trying so hard to do.

"AMNESIA often can be remedied by suggestion. Sometimes when the physician isn't able to get an amnesia patient to talk, he can induce him to write, and from what is written, almost unconsciously, the cause of the trouble is learned and so cured."

The fact that suggestion often can recall to the amnesia victim's mind the things he has forgotten proves that amnesia does not cause loss of memory, but merely loss of the *use* of memory, and so offers hope to all sufferers from this mysterious malady.

Naturally, amnesia sometimes is faked by criminals seeking to avoid payment of the law's penalty for their misdeeds, and often juries have trouble deciding between real and assumed amnesia.

Out of a charge that a criminal was faking amnesia and impersonating another man, grew one of the most puzzling and sensational cases that the Italian courts have tried for many years.

Giulio Canella, an Italian college professor, became an officer in the Italian army during the World War. By some mischance, he was not fingerprinted when he entered the service. After a battle in Albania, he was reported missing and probably killed.

In 1924 a man was found wandering in a dazed condition near a cemetery in Turin. He was placed in the Collengo asylum. Sometime later, Professor Canella's wife identified the unknown man of Collengo as her husband. Dimly, he seemed to know her. Relatives and friends accepted him as Canella.

Signora Canella had him taken to her home. His mental condition improved rapidly. After a few months he seemed to regain his memory; he recognized all his old friends and recalled many incidents of his past life. He even wrote a book about his experience that showed a high degree of culture.

THEN came trouble in the form of a woman who claimed that the unknown man was her husband, Mario Bruneri, a typesetter who several times had been in trouble with the police, and who had disappeared while they were looking for him on a charge of having stolen a bronze burial urn from the cemetery near which the unknown man had been found.

There was a long legal battle. The police proved that the fingerprints of the unknown man were exactly the same as Bruneri's. Signora Canella's lawyers did not dispute this, but claimed that, as Professor Canella had not been fingerprinted when he entered the army, there was no proof that the unknown man's fingerprints and Canella's would not correspond. They put the book that he had written into evidence, with the claim that it was impossible that a man of Bruneri's limited education could have written it.

The court decided that the unknown man was Bruneri, and that he would have to go to prison. Signora Canella appealed. She lost the appeal. Then she appealed to the supreme court where the case is pending.

FLYWEIGHT PORTABLE IS EASILY BUILT

(Continued from page 55)

follows: Upper end of grid coil to G pin of tube base, lower end of grid coil to the —F pin, upper end of tickler coil to P pin, and the lower end of the tickler to the +F pin.

If you do not desire to have the set cover the range of the long-wave weather stations, this special coil can be eliminated. Even without it, the regular set of six coils, used correctly with the shorting switch open for the short waves and closed for the long waves, will allow you to tune up to approximately 750 meters. The special long-wave coil was included to meet the requirements of those amateurs who may be interested in the detailed reports given periodically by the long-wave aviation weather stations throughout the country.

AS SHOWN in the illustrations, a composition subpanel, placed about 3 in. up from the bottom of the front panel, supports the tube and coil sockets. First, lay out the front panel and cut and drill the holes for the meter, transformer and subpanel bolts, binding posts, and rheostat, resistance, and condenser shafts. Also cut the four holes for the bolts that hold the front panel in place.

The tuning condenser (B) is mounted directly under the center of the subpanel, the transformer (K) to the left under the amplifier tube (G), and the grid condenser (F) and auxiliary condenser (C) with its shorting switch to the right. A brass strip is used in connecting together the two fixed condensers (F and C) so they can be mounted as a unit. By using a short length of heavy wire for the connection between the auxiliary condenser (C) and the stator of the variable condenser (B) it can be made to serve as the support for both fixed condensers. A short length of stiff wire, mounted on one of the bracket bolts close to the front panel, supports the other end of the fixed condenser assembly. The shorting switch is mounted directly on the terminals of the auxiliary condenser (C), as shown in the bottom-view photograph.

All ground connections, shown in the schematic diagram, are made to a narrow strip of brass mounted across the tops of the two aluminum brackets for the subpanel, between the subpanel and the front panel. This eliminates the bother of soldering to the aluminum.

The set box is made entirely of ⅜-in. poplar. A shelf placed 2¾ in. up from the bottom piece separates the set compartment from the B battery, earphone, and A battery compartments. Shoulders to receive the four front panel bolts are placed each side of the set compartment.

TWO ⅜-in.-thick partitions divide the lower compartment into three sections. The one at the left receives the two-cell A battery, the antenna, and the counterpoise; the one in the center, the earphones; and the one at the right, the B battery. The flashlight-cell A batteries are connected in series by means of clips cut from spring brass or bronze and screwed to the back of the compartment. A long clip is placed at the bottom to connect the positive of one cell to the negative of the other and two separate clips placed at the top make the —F and +F connections. Wires lead from these two upper spring terminals to the fahnestock clips marked —F and +F mounted on the inside back of the set compartment.

Four fahnestock clips, mounted on the top side of the dividing shelf, receive the earphone cord tips and the two B battery leads. These wires are led up from the bottom compartments through holes in the dividing shelf. Two additional fahnestock clips, (marked 2 and P) mounted in a line with the —F and +F clips on the cabinet back, are connected to the phone tip terminals. These four clips (—F, +F, 2, P) serve for connecting in the set before the front panel is put in place. Enough slack should be provided in the connecting wires leading from the set to allow the front panel to be removed for the insertion of the coils and the manipulation of the shorting switch.

In the photographs, four binding post terminals are shown mounted on the front of the panel; two at the left and two at the right. The two left-hand terminals are for the antenna (upper) and counterpoise (lower) and the two at the right are used only for outside battery connections when an auxiliary battery, such as an air cell, is available. When using an external battery, the portable A cells must be removed.

SINCE the counterpoise and auxiliary +F terminals are connected to ground, the lower binding post on each side of the panel need not be insulated and can be used to take the place of the lower bolts holding the subpanel brackets in place. The upper binding posts, the antenna on the left and the auxiliary —F on the right, must be insulated from the metal panel.

To fit the headphones in the small middle compartment, it will be necessary to remove the rigid headband usually used and substitute a pliable leather strap. This need be nothing more than a narrow strip of soft leather reënforced at the ends where the holes to receive the earpieces are cut. By making the holes a tight fit, the phones will remain in place without any other fastening. A length of ordinary elastic tape fastened to the ends of the strap can be added, if desired, to hook under the chin and hold the earphones firmly against the ears. The entire outfit can be folded and inserted in the small 2½ by 2¾ in. storage space provided.

Of course, in constructing the cabinet, it will be well to wait until after the set itself has been completed. Any changes, due to the parts used, may make slight alterations in size and general design necessary. For ease in handling, provide a brass or leather handle on the top of the cabinet and for protection equip the box with brass corners.

To use the companion portable, rig the short antenna and the counterpoise, insert the coil for the band desired, and adjust the filament rheostat (D) for a 2-volt reading on the voltmeter (L). Then with your left hand control the 50,000-ohm tickler resistance (A) and with your right hand the tuning condenser (B). Don't forget, however, that the shorting switch on the auxiliary condenser (C) must be *open* when using the four short-wave coils and *closed* when using the three long-wave coils. In the original, careful calibration showed that the four short-wave coils tuned from 15 to 190 meters and the two broadcast coils from 190 to 750 meters.

WHEN rigging the antenna and counterpoise, place them as far apart as possible, with the antenna as high as it will go and the counterpoise lying on the ground or connected to the frame of a car or other large piece of metal. Of course, better results will be obtained if a regular antenna is used.

PILOTS FLYING ANDES GET WEATHER DATA

PILOTS flying over the Andes from Santiago, Chile, to Mendoza, Argentina, now get weather reports at fifteen-mile intervals. On the summit of the Uspallata Pass, at an altitude of 12,500 feet, a new observatory has been established. It radioes reports every few minutes to the flyers.

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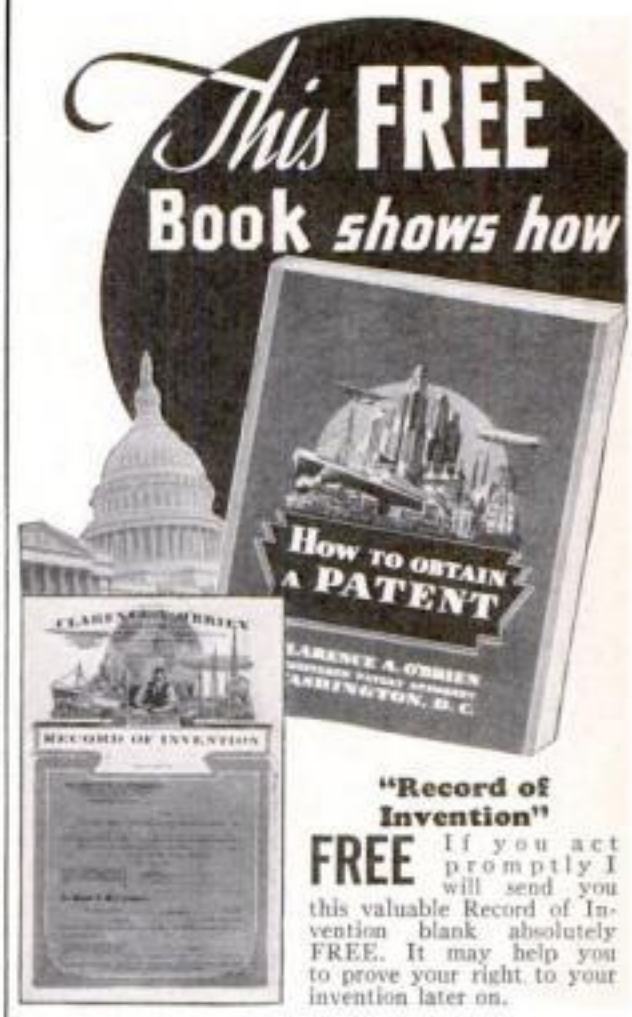

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POLICE OUTWIT CROOKS OF THE AIR

(Continued from page 29)

L. I., it fluttered down to the roof of an apartment building. The owner said he had rented a dovecot on the roof to a man who came every day to care for his pigeons. When the man turned up, later in the day, he was arrested, tried, and sentenced to five years in the penitentiary for attempted extortion.

This brilliant bit of aerial strategy was reported in papers around the world and soon afterwards it was duplicated at Bochum, Germany, and in Argentina. In both places, the air police were able to shadow colored pigeons and solve extortion plots.

In New York City, the air unit of the police comprises four planes and fourteen men. During the three years of its existence, this unit has flown daily patrols which have rid New York of air accidents and stunting over the city. In addition, a number of rescues in the East River and on the bay have been credited to the aerial patrolmen. In New Jersey, the state police have used aircraft to search for escaping criminals, to plot territory in establishing police dragnets, and to transport officials, witnesses, and anti-toxins in emergencies.

DURING a parade in New York City, last year, the blimp, *Resolute,* floated for five hours 2,000 feet above the marchers to enable police officials to direct traffic below. Following the course of the parade with field glasses, they radioed instructions for straightening out snarls in traffic to special receiving stations set up along the line of march. Ten radio cars and as many motorcycle cops were standing by to carry out the orders.

When the recent earthquake struck Long Beach, Calif., telephone service was interrupted and wild rumors of fire, tidal waves, and terrible destruction ran rapidly over the city. Jimmy James, police pilot of a two-way radio-equipped ship, flew over the stricken territory and gave police the only authentic information they had during the first hour and a half or more. James was constantly in touch with headquarters and reported the conditions, vastly aiding in rushing emergency supplies.

Attached to the aerial police at Los Angeles, is a volunteer aero squadron made up of special deputy sheriffs subject to call in emergencies. All hold transport, military, or naval licenses and wear distinctive badges and carry special insignia on their ships. Among the members of this squadron are: Ross Hadley, round-the-world flyer, Charles M. James, Superintendent of Western Air Express, and Howard Hughes, well-known moving picture producer.

IN ADDITION, there is a Federal Emergency Detachment, acting in an advisory and cooperating capacity with the air police. Membership comprises commanding officers of army, navy, and national guard units. Nowhere else in the world, the police say, are the military and police forces of the air so organized for cooperative purposes. Some 2,000 flyers and 650 planes are thus placed on call for use in an emergency.

Other cities, Philadelphia, Pa., Chicago, Ill., Denver, Colo., are giving special attention to building up air police units and several states, notably New Jersey and California, are equipping state troopers with planes. In the far north, red-coated officers of the Royal Northwest Mounted Police are using wings to get their men.

Transporting prisoners to trial or to the penitentiary is another job which sometimes falls to the lot of the flying patrolman. One of the first instances of the kind occurred in New York where a murderer, condemned to the electric chair, was flown to Sing Sing. He protested violently that flying to the prison was too dangerous.

Not long ago, a suspect in a California murder case was seen boarding a train bound east. In order to interrogate him before he crossed the state line, police raced by plane after the train, stopped it, and examined the suspect.

An army plane equipped with machine guns is used to guard the payroll of government employees at Wright Field, Dayton, O. The truck which transports the money from a Dayton bank, accompanied by an armored car and an open machine carrying crack-shots, has a yellow insignia painted on its top. This distinguishes it so the pilot can hover overhead during the trip to the field, ready for an emergency.

PROBABLY the hottest sector in the battle between the air police and flying gangsters is along the Rio Grande on the Mexican border. One underworld ring, charging a thousand dollars a head for smuggling aliens into California, is said to own a dozen high-powered transport planes.

Although government agents work extensively from tips obtained from the underworld, the aerial police sometimes spot a smuggler's plane by the way it flies.

In this way, four U. S. Border Patrol pilots, Clem Hensler, Jack Tulley, Roy Wall, and Buddy LeVine, recently spotted a big cabin plane south of Los Angeles. Noting it was flying with an unusually heavy load, they cruised after it, ordered it down and found it carried a cargo of aliens. The pilot was arrested and the ship was confiscated.

A recent addition to the aerial army fighting smugglers is a fleet of five huge flying boats in which crack Coast Guard pilots patrol the Atlantic seaboard, with stations at Gloucester, Mass., Cape May, N. J. and Miami, Fla. Each of the blue and silver planes carries two 420-horsepower Wasp motors and is equipped with special apparatus for saving lives at sea. In addition to first-aid and fire-fighting equipment, they carry rubber lifeboats which can be inflated quickly with carbon-dioxide and will support six men.

On a number of occasions, these aerial cutters of the coast patrol have picked up fishermen blown out to sea and have taken sailors, dangerously ill, from vessels and transported them to hospitals on shore. Their oddest job so far has been seeing how high in the air they could gather pollen spores—for the U. S. Department of Agriculture.

Another new craft which offers great possibilities in crime-fighting from the sky is the autogiro. With its ability to hover over one spot and to descend vertically, it has advantages over ordinary planes in trailing and attacking criminals. This was demonstrated in a dramatic way in Pennsylvania, a few weeks ago.

NEAR Philadelphia a crack shot of the Pennsylvania police took off in a flying windmill. On the field below, a "bandit car" was sent racing over the ground with nobody in it. The autogiro pilot swooped down on the car and the police officer riddled it with machine gun fire. Of seventy-seven bullets fired, thirty-five struck the car and stopped it by tearing through the gasoline tank.

One important part of the work of the aerial patrol is outwitting the strategems of criminals who take to the air. New tricks are constantly being tried. Recently, for example, a plane landed with an innocent-looking cash register which the pilot said he had ferried from another town for a friend. Unfortunately he slapped down in a hard landing and the drawer of the cash register popped open, revealing inside a dozen packages of opium, smuggled over the line from Canada.

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RAILWAYS FIGHT FOR LOST TRAFFIC

(Continued from page 11)

good many feet the highest railroad fills in the world. It would have been an endless job under the old methods, with hand scrapers nibbling at that mountain mass and tossing it half a yard at a time into a seemingly bottomless gulch. As it was, the whole mountain top was dumped into the canyon by a couple of power shovels and seven five-ton trucks, operated by a dozen men.

IN THE side of the mountain opposite Indian Falls, "gophers," or miners, worked seventy days and nights digging "coyote" holes, or tunnels, "down holes," and cross-cuts, and filling this subterranean maze with fifty tons of black powder, two tons of dynamite, and 2,500 feet of copper wire. Then they were ready for the biggest powder shot ever made on a railroad job. Three hundred Indians, cowboys, and other spectators took gallery seats 1,500 feet across the canyon. Three hundred feet off in another direction a powder man touched a plunger.

After the blast, a section as tall as a ten-story building, as long as two city blocks and as wide as one, was missing from the mountain. This 175,000 tons of earth provided just the 115,000 cubic yards needed to put a fill across that quarter-mile canyon.

Since there are mountains that are too big to be blown out of the way, there are a few tunnels—nine on the entire extension. That is surprisingly few for a 112-mile stretch of road through the mountains. The secret lies in the fact that at the height of a mile, most of the mountains are underneath the roadbed, and the rest are so narrow that it's a simple matter to go around them.

Even the nine tunnels did not take as much time or trouble as one sizeable bore would have done in the old days. When solid rock had to be attacked with hand-drills, it was often a year's job. On this road all nine tunnels were built inside of a year, and by the same men.

The answer is compressed air. High-voltage power lines were brought in over the tree-tops on giant towers. Here and there along the route of the extension, transforming stations were set up, and current from these operated huge air compressors at each tunnel entrance. For work deep within the tunnels, portable compressors were used. The result was that hard rock, which has ruined many a contractor in the past, actually gave way faster than the soft dirt which they used to hope for.

Just as some of the mountains were too big to be moved, so there were canyons too wide and deep to be filled by tossing mountain tops into them. In the old days, such problems were met by going around the canyons. What this road did in such cases may be illustrated by its procedure at Clear Creek.

The proposed line at this point was 220 feet above the bottom of the canyon. A viaduct tall enough to carry the road across would have to be built on skyscraper proportions, approximately the height of a twenty-story building. And that is exactly what was constructed—a skyscraper framework twenty stories high and more than a tenth of a mile long.

THERE are a number of reasons why this method of solution was not generally available for similar railroad problems in the past. One is that most of the roads were built before there were any skyscrapers to serve as models. Another was the difficulty of getting the necessary materials into the mountains. So the old method was to build temporary wooden bridges for the construction road, and then to bring the material for the permanent structures in by train. The permanent structures, then, could be no longer than the wooden ones, which of course eliminated the possibility of skyscraper construction.

The tractor has changed all that. Tractors can go anywhere, and if forests get in the way, other tractors can pull these up by the roots. So tractors brought the countless tons of steel into the mile-high mountains; and power lines and the science of arc welding brought the means of fashioning these, in the midst of a vast wilderness, into giant viaducts that enabled the road to run straight and true to its course.

All the work on this road was flood-lighted at night by traveling electric plants operated by gasoline engines. There were three shifts of men at work, and about thirty-five percent of the road was being built between sundown and sunrise.

Because of this three-shift schedule and the capacity of the machines, the construction period was shortened beyond the dreams of the engineers. They estimated it would take two years. Actually, the road was ready for operation in eighteen months.

THE engineers estimate that if they had had to use hand labor instead of equipment labor, it would have taken 5,000 men three years to build the extension. At $1,000 a year per man, the labor cost would have been $15,000,000. As it was, the road was built by 900 skilled men getting $3,000 a year each, making the labor cost only $4,500,000. Offhand, this would seem to have worked a hardship on the men whose places were taken by the machines. As a matter of fact, if the old cost had prevailed, the extension probably would not have been built, and this would have deprived a good many men of permanent jobs in the future.

To the old-time railroad man everything is different, with one exception: the men are still the same. The mule skiner is gone, but in his place is the "cat" skinner, which is what they call the man who handles a tractor. The old mule skinner was hardy, fearless, and about twice as tough and stubborn as any of his mules. And the cat skinner is his blood brother.

There's another thing that hasn't changed much, either, and that's the background. The cowboys and Indians who watched the mountain top blown off belong right in the neighborhood. The region is as much the Old West as it was back in the sixties.

INTO this almost primitive setting has come suddenly this ultra-modern railroad, with its ten-story fills and its skyscraper viaducts, and its careless way of tossing mountain tops into canyons. It's as sharp a contrast between the old and the new as could be found on this continent.

An area as long as Ohio and as wide as Connecticut will be directly affected by the coming of the road. In it are nearly 500,000 tillable acres, of which more than half have never been cultivated because they were too far from a railroad. There are 36,000,000,000 board feet of timber which for the same reason could not be marketed.

Aside from the purely utilitarian benefits that modern machinery has thus brought to the region, it has presented the nation with a new scenic attraction. For nearly 100 miles the traveler along the top of the one range will have an unobstructed view of the next range, twenty miles distant, which includes Mts. Shasta, Lassen, Burney, and Magee.

By employing new equipment, new engines, new trains, the American railroads are speeding up construction and traffic, cutting costs, and staging what promises to be a dramatic comeback.

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Electric Eye Guides Hands at a Thousand Jobs

(Continued from page 21)

amount of ultra-violet light which passes through the smoke-laden air above big cities. When the photo-electric cell is equipped with special filters it becomes sensitive only to certain kinds of light rays. Thus it is a simple matter to measure the proportion of infra-red, ultra-violet rays in the light at any time.

Another column may soon be added to the daily tabulations of the U. S. Weather Bureau. Tests are being planned for determining the amount of illumination from the sun which reaches the earth each day, together with the amount of moonlight which reaches the earth each night. Special electric eye recorders are being developed for the purpose.

IN NEW YORK CITY recently an inventor demonstrated the manner in which a battery of robots, under the command of a magic lamp, would attack a burglar attempting to crack a safe. In the wink of an eye, after a beam of invisible ultra-violet light in front of the safe is intercepted, the robots go into action. A burglar alarm wails. A flashlight flares. A camera snaps a photograph of the intruder, while a fourth device volleys out tear gas which leaves the thug struggling around helpless until the police arrive.

The fight against another member of the underworld, the counterfeiter, is also aided by the magic eye. Slight variations in the color of banknote paper are being noted in one American money printing plant by photo-electric detectors, so all the bills will be of uniform hue, thus making it easier to recognize a counterfeit.

The fact that different shades of the same color reflect different amounts of light is the basis of many industrial applications of the electric eye.

In Detroit, Mich., automobile factories are installing automatic "electric eye forges." When a bar of steel in these electric heating chambers reaches the desired temperature, its color, always the same at that point, affects a photo-electric cell and the bar is automatically removed. English scientists, with the aid of a magic eye, are searching for new steels at Sheffield University. It records the rise and fall of temperature in the experimental electric furnaces, keeping an accurate record by the color changes of the metal.

A rule in factories where high-priced cigars are made is that the top layer of every box must contain cigars of uniform hue. Tobacco the same color is now picked out for cigars by photo-electric cells which work faster and more efficiently than human eyes.

MATCHING delicate shades of cloth and dyes is also accomplished in the same manner. A colorimeter, recently devised, picks out variations in hues imperceptible to the most highly trained human eye. Another application of the ability of the electric eye to distinguish shades of color is a remarkable device invented by a London, England, doctor. It separates the hue of a paint or dye into its three primary colors and gives the exact proportion of each. Thus, the identical shade of an unknown dye or paint can be reproduced at any time without costly experimenting. Again, the amount of haemoglobin, or red coloring matter, in the blood is measured in hospitals by means of a magic eye.

A thousand dollars a week is being saved in one New York newspaper plant by an ingenious apparatus which looks like a lathe, but which, under the guidance of a light-sensitive cell, makes half-tone engravings and three-color plates in a sixtieth the time required by the old acid-etching process. Plates for half-tones, the ordinary black and white pictures in newspapers, are turned out by the photo-electric lathe at a cost of only three-quarters of a cent a square inch.

In other ways, electric eyes are helping get out the daily paper. In one Eastern plant, presses are equipped with an automatic device that stops them instantly if the paper breaks. Light, directed upward from beneath the paper feeding into the press, strikes a photo-electric cell if the ribbon parts and thus avoids costly loss of time and paper.

To determine if paper is sufficiently opaque to keep printing from showing through and disturbing the reader, one New York daily examines rolls with a photo-electric opacity meter. Five hundred samples have been analyzed in this way to find which is best suited to the needs of the publication.

A few months ago, in the Texas oil fields, another problem was solved by an electric eye. In the treating process in refining gasoline, after the cracking is over, it is important to have all the fuel of uniform color. Fuel darker than standard, contains too much carbon. Special watchmen were placed in one plant before glass tubes through which the gasoline ran. But human eyes tire easily and color changes frequently went unnoticed. So the job has been turned over to mechanical eyes that never tire. Rays of light pass through the tubes to photo-electric cells. The slightest color variation in the fuel causes a change in the amount of light reaching the cells and sounds an alarm.

When you go to the theater and hear a talking picture, light-sensitive cæsium cells make your entertainment possible. The same sort of electric eye is used in television and in sending pictures by telegraph and radio. Cæsium cells are employed because this metal is particularly sensitive to red rays which predominate in light from the incandescent lamps used in talkies and television.

In the factories where photo-electric cells are manufactured, the explosion of small cæsium pills within the glass tubes spatter the inside of the glass with the metal just as stucco is splattered on the exterior of a house. The pills are set off by the heat of special radio waves played upon the tube after the air has been exhausted within it. All metals are sensitive to light in some degrees, even iron. Photo-electric cells have been made by using zinc for the lining of the glass. But only the rare earth metals, such as caesium, thallium, rubidium, are sensitive enough for use in modern cells.

Over an Ohio airport, one night a few weeks ago, a big airplane wheeled in pitch darkness. Suddenly a slender white finger of light shot downward from a small searchlight mounted on the fuselage of the aircraft. It probed back and forth over the field until its beam struck a photo-electric cell near the hangars. Instantly, the floodlights flared on illuminating the field for a landing. An automatic apparatus, by means of which a pilot can turn on the lights of a field from the air, had proved a success. A similar device has been worked out to enable a flyer to switch off the lights after a takeoff by sending down a beam from the sky as he flies away.

All day long, a photo-electric robot counts people entering the main Public Library in New York City. A score of others count all automobiles crossing the Ambassador Bridge between Detroit, Mich., and Windsor, Canada. Others, buried in the pavement concrete of the Holland Tunnel, under the Hudson River from New York City to Jersey City, N. J., count the cars speeding past.

At the intersection of Trenton Avenue and the Lincoln Highway, in Wilkinsburg, Pa., the light is always green for traffic on the highway except when a car approaches the corner of the side street, which has comparatively little traffic. Then the light changes to red until the car has passed and then switches to green again as if by magic. Photo-electric cells and beams of light stretching across the side street automatically change the lights when a car approaches.

Special tests are made on the sprinters of one Eastern university to discover where they lose fractions of a second in the hundred-yard dash. At ten-foot intervals, electric eye timing devices record their speed on paper disks, giving it to a thousandth of a second. Study of these records show where the athletes slow down and where extra training was necessary.

Every time a player steps over the foul line in a Schenectady, N. Y., bowling alley, a red light flashes on. He has stepped on a beam of light trained across the alley on an electric eye. The decision of this automatic umpire is infallible and is accepted by contestants without question.

TURNING on the fountain as you bend over for a drink; swinging open the garage doors as you drive up with your headlights on; cutting off hot steel rods at exactly the same length as they rush at fifteen miles an hour from the rolls; picking out rust spots, holes, and thin places in sheet metal; shunting mailbags and material on conveyor belts to the right destination, and sorting and filing cards in different compartments according to combinations of stencils cut in the pasteboard, are other astonishing feats of these light-sensitive miracle tubes.

What lies ahead for these miracle cells? The most dramatic accomplishment of all, many scientists believe: the transmuting of sunlight into electric current!

In several part of the world, researches with light-sensitive materials are being carried on with this end in view. In Germany, Dr. Bruno Lange, with his chemical sandwiches, has succeeded in keeping a light burning day after day with current from the sun. (P. S. M., p. 41, Jun. '31.) While all the apparatus so far constructed has been too inefficient for commercial application, many experts believe that the researches stimulated by the feats of the photo-electric cell, the wonder tool of today, will eventually lead to a practicable means of tapping the power in sunlight.

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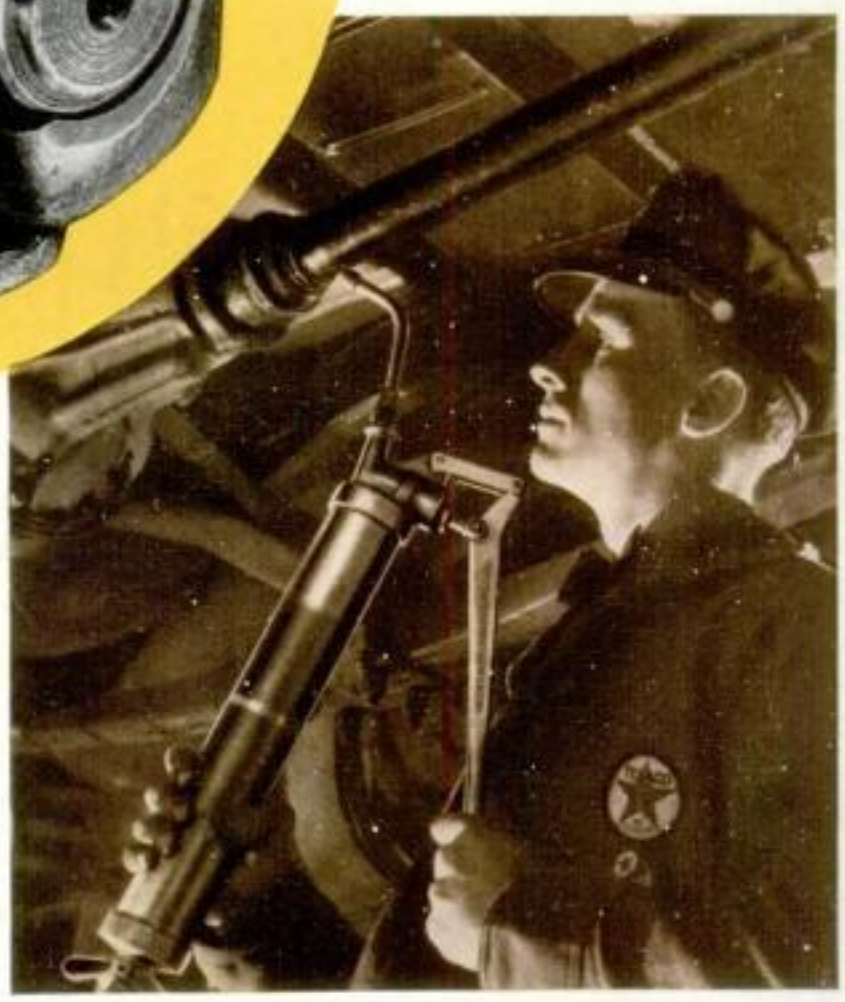

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